STATINTL

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100%

[redacted]

G. CARRIER HANDBOOK OF A/C SYSTEM DESIGN, 1965 EDITION
H. MANUFACTURER'S CATALOG & STANDARDS

I DESIGN DATA

A. DESIGN TEMPERATURES

a. AMBIENT	93°FDB & 79°FWB @ 128 GR/LB.	
b. ROOM	78°FDB & 50% RH @ 72 GR/LB.	
c. DIFFERENCE	15°F	56 GR/LB.

B. TEMPERATURE CORRECTIONS

a. DIFFERENCE = 15-15 = 0°F

b. DAILY RANGE = $\frac{20-12}{2}$ = +4°F

c. NET CORRECTION = 0 + 4 = +4°F

C. FINAL TEMPERATURE DIFFERENTIAL @ 1800 HRS.

a. ROOF, 6" CONCRETE W/ 2" INSULATION = 44 + 4 = 48°F

b. 8" CHB WALLS, LIGHT COLORED

N = 6+4 = 10°F E = 10+4 = 14°F
S = 12+4 = 16°F W = 14+4 = 18°F

c. PARTITIONS

ADJACENT TO NON-A/C ROOM = 15-5 = 10°F
ADJACENT TO KITCHEN = 15+10 = 25°F
ADJACENT TO MECH. ROOM = 15+10 = 25°F

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D HEAT GAIN THROUGH GLASS
a. OVER-ALL GLASS FACTOR = 1.06
b. SHADING COEFFICIENT = 0.60
c. SOLAR HEAT GAIN @ 1800 HRS.
N = 35 BTH/SF-HR E = 5 BTU/SF-HR
S = 5 BTH/SF-HR W = 102 BTU/SF-HR

E. HEAT GAIN FROM OCCUPANTS @ 78°F DB
a. METABOLIC RATE = 450 BT-H
b. SENSIBLE HEAT = 215 BTUH
c. LATENT HEAT = 235 BTUH

F. OUTSIDE AIR REQUIREMENT, TABLE 45 REF G P1-97
RECOMMENDED = 15 CFM/PERSON

G. COEFFICIENT OF HEAT TRANSMISSION
a. ROOF

OUTSIDE AIR @ 7½ MPH	0.25
BUILT-UP ROOFING	0.33
6" CONCRETE SLAB @ 0.08"	0.48
AIR SPACE	0.97
2" MINERAL WOOL INSULATION	6.90
½" ACOUSTICAL TILE	1.19
INSIDE AIR	0.92
TOTAL RESISTANCE,	R_T = 11.04
	U = 0.091 SAY 0.10

b EXTERIOR WALLS

OUTSIDE AIR @ 7½ MPH	0.25
8" CMB	1.11
INSIDE AIR.	0.68
TOTAL RESISTANCE,	R_T = 2.04
	U = 0.49

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G. COEFFICIENT OF HEAT TRANSMISSION

b. EXTERIOR WALLS (CONT.)

OUTSIDE AIR @ 7½ MPH	0.25
8" CHB	1.11
AIR SPACE	0.97
6" CHB	0.63
INSIDE AIR	0.68
TOTAL RESISTANCE,	$R_T = 3.64$
	$U = 0.26$

c. PARTITIONS

INSIDE AIR	0.68
8" CHB	1.11
INSIDE AIR	0.68
TOTAL RESISTANCE	$R_T = 2.47$
	$U = 0.405$ SAY 0.41

INSIDE AIR	0.68
6" CHB	0.63
INSIDE AIR	0.68
TOTAL RESISTANCE	$R_T = 2.19$
	$U = 0.46$

H. LIGHTING LOAD : USE 3 WATTS / SF

I. LOAD ESTIMATES : SEE FOLLOWING PAGES

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A/C LOAD ESTIMATE

CEILING HEIGHT = 8-0

ROOM RECEPTION & LOUNGE ROOM SIZE 16x19 = 304 SF V = 2736 CF

ITEM	QUANTITY	DIFFERENCE	FACTOR	BTU PER HR
SUNLIGHT GAIN				
W GLASS	50 FT²	x 102	B/FT²/HR x 0.60	3060
S GLASS	50 FT²	x 5	B/FT²/HR x 0.60	150
N GLASS	FT²	x	B/FT²/HR x	
E GLASS	FT²	x	B/FT²/HR x	
SKYLIGHT	FT²	x	B/FT²/HR x	
ROOF	FT²	x	B/FT²/HR x	
TRANSMISSION GAIN				
ALL GLASS	100 FT²	x 5	°F x 1.06	1590
W WALL	94 FT²	x 8	°F x 0.49	830
S WALL	12 FT²	x 16	°F x 0.49	950
N WALL	FT²	x	°F x	
PART.	63 FT²	x 25	°F x 0.46	720
PARTITION	20 FT²	x 10	°F x 0.46	460
CEILING	304 FT²	x 48	°F x 0.10	1460
FLOOR	FT²	x	°F x	
INFILTRATION & OUTSIDE AIR				
INFILTR.	CFM x	°F x 1.03		
INTERNAL HEAT				
PEOPLE	4 PEOPLE	x 215		860
MOTORS	HP x 746 x 3.4 x			
LIGHTS	3x304 WATTS x 3.4 x			3100
FLOOR				
ROOM SENSIBLE HEAT SUBTOTAL				13270
SAFETY FACTOR	10 %			1327
ROOM SENSIBLE HEAT				14600
ROOM LATENT HEAT				
INFILTR.	CFM x	GR/#	x 0.68	
PEOPLE	4 PEOPLE	x 235		940
STEAM	x	LB/HR	# 1000	
ROOM LATENT HEAT SUBTOTAL				940
SAFETY FACTOR	10 %			95
ROOM LATENT HEAT				1035
ROOM TOTAL HEAT				15635
OUTSIDE AIR HEAT				
S. H.	CFM x	°F x 1.08		
L. H.	CFM x	GR/H x 0.68		
GRAND TOTAL HEAT SUBTOTAL				
TONS =	GRAND TOTAL HEAT			
SENS HEAT FACTOR =	ROOM SENS. / ROOM TOTAL =			

ESTIMATES FOR AM / PM PEAK

CONDITIONS	DB	WB	% RH	DP	GR PER LB
OUTSIDE					
ROOM					
DIFFERENCE					

VENTILATION

4 PEOPLE NOT SMOKING x 15 CFM/PERSON = 60

PEOPLE SMOKING x CFM/PERSON = CFM VENTILATION =

INFILTRATION

SWINGING / REVOLVING DOORS PEOPLE X CFM/PERSON =

OPEN DOORS DOOR X CFM/DOOR =

EXHAUST FAN

CRACK FEET X CFM/FT =

CFM INFILTRATION

DEHUMIDIFIED AIR

(1 - B. F.) x (F. RMT. - F. APP. DP) = F DEHUM RISE

ROOM SENS. = CFM

1.08 x F DEHUMIDIFIER RISE

NOTES

OUTSIDE AIR @ 1 AIR CHANGE

OA = 2736 x 1/60 = 45.5 CFM < MIN 50 CFM

USE 50 CFM OUTSIDE AIR

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A/C LOAD ESTIMATE

ROOM OFFICE SIZE 13X19 = 247 SF V = 2223 CF

ITEM	QUANTITY	DIFFERENCE	FACTOR	BTU PER HR
SUNLIGHT GAIN				
W GLASS		FT² x	B/FT²/HR x	
S GLASS	50	FT² x 5	B/FT²/HR x 0.60	150
N GLASS		FT² x	B/FT²/HR x	
E GLASS	25	FT² x 5	B/FT²/HR x 0.60	75
SKYLIGHT		FT² x	B/FT²/HR x	
ROOF		FT² x	B/FT²/HR x	
TRANSMISSION GAIN				
ALL GLASS	75	FT² x 15	°F x 1.06	1190
W WALL		FT² x	°F x	
S WALL	12	FT² x 16	°F x 0.49	950
N WALL		FT² x	°F x	
E WALL	92	FT² x 4	°F x 0.49	630
PARTITION		FT² x	°F x	
CEILING	247	FT² x 48	°F x 0.[illegible]	1[illegible]30
FLOOR		FT² x	°F x	
INFILTRATION & OUTSIDE AIR				
INFILTR.		CFM x	°F x 1.08	
INTERNAL HEAT				
PEOPLE	4	PEOPLE x 215		860
MOTORS		HP x 746 x 3.4 x		
LIGHTS	3x247	WATTS x 3.4 x		2520
FLOOR				
ROOM SENSIBLE HEAT SUBTOTAL				7505
SAFETY FACTOR		10 %		760
ROOM SENSIBLE HEAT				8325
ROOM LATENT HEAT				
INFILTR.		CFM x	GR/# x 0.68	
PEOPLE	4	PEOPLE x 235		940
STEAM		x LB/HR	# 1000	
ROOM LATENT HEAT SUBTOTAL				
SAFETY FACTOR		10 %		95
ROOM LATENT HEAT				1035
ROOM TOTAL HEAT				9360
OUTSIDE AIR HEAT				
S. H.		CFM x	°F x 1.08	
L. H.		CFM x	GR/H x 0.68	
GRAND TOTAL HEAT SUBTOTAL				

TONS = GRAND TOTAL HEAT

SENS HEAT FACTOR = ROOM SENS. / ROOM TOTAL

ESTIMATES FOR AM / PM PEAK

CONDITIONS	DB	WB	%RH	DP	GR PER LB
OUTSIDE					
ROOM					
DIFFERENCE					

VENTILATION

4 PEOPLE NOT SMOKING x 15 CFM/PERSON = 60

PEOPLE SMOKING x ____ CFM/PERSON = ____

CFM VENTILATION = ____

INFILTRATION

SWINGING REVOLVING DOORS ____ PEOPLE X ____ CFM/PERSON = ____

OPEN DOORS ____ DOOR X ____ CFM/DOOR = ____

EXHAUST FAN ____

CRACK ____ FEET X ____ CFM/FT = ____

CFM INFILTRATION

DEHUMIDIFIED AIR

[1 + ____ B.F.] X [____ R. RMT. - ____ F. APP. DP] = ____ # DEHUM BTUH

ROOM SENS. / # DEHUMIDIFIER BTUH = ____ CFM

1.08 x

NOTES

OUTSIDE AIR = 1 AIR CHANGE

OA = 2223 x 1/60 = 37 SAY 40 CFM

USE 60 CFM OUTSIDE AIR

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A/C LOAD ESTIMATE

ROOM OFFICE SIZE 13X19 = 247SF V= 2223 CF

ITEM	QUANTITY	DIFFERENCE	FACTOR	BTU PER HR
SUNLIGHT GAIN				
W GLASS		FT² x	B/FT²/HR x	
S GLASS		FT² x	B/FT²/HR x	
N GLASS		FT² x	B/FT²/HR x	
E GLASS	25	FT² x 5	B/FT²/HR x 0.60	75
SKYLIGHT		FT² x	B/FT²/HR x	
ROOF		FT² x	B/FT²/HR x	
TRANSMISSION GAIN				
ALL GLASS	25	FT² x 15	°F x 1.06	400
W WALL		FT² x	°F x	
S WALL		FT² x	°F x	
N WALL		FT² x	°F x	
E WALL	92	FT² x 2	°F x 0.49	630
PARTITION	7	FT² x 5	°F x 0.41	760
CEILING	247	FT² x 28	°F x 0.10	1190
FLOOR		FT² x	°F x	
INFILTRATION & OUTSIDE AIR				
INFILTR.		CFM x	°F x 1.03	
INTERNAL HEAT				
PEOPLE	2	PEOPLE x 215		430
MOTORS		HP x 746 x 3.4 x		
LIGHTS	3 x 247	WATTS x 3.4 x		2520
FLOOR				
ROOM SENSIBLE HEAT SUBTOTAL				7005
SAFETY FACTOR	10 %			700
ROOM SENSIBLE HEAT				7705
ROOM LATENT HEAT				
INFILTR.		CFM x	GR/# x 0.68	
PEOPLE	2	PEOPLE x 225		470
STEAM		x	LB/HR # 1000	
ROOM LATENT HEAT SUBTOTAL				
SAFETY FACTOR	10 %			50
ROOM LATENT HEAT				520
ROOM TOTAL HEAT				8225
OUTSIDE AIR HEAT				
S. H.		°F x 1.08		
L. H.		CFM x GR/H, x 0.68		
GRAND TOTAL HEAT SUBTOTAL				
TONS =	GRAND TOTAL HEAT			
SENS HEAT FACTOR	ROOM SENS. / ROOM TOTAL =			

ESTIMATES FOR	AM PM	PEAK			
CONDITIONS	DB	WB	%RH	DP	GR PER LB
OUTSIDE					
ROOM					
DIFFERENCE					

VENTILATION

2 PEOPLE NOT SMOKING x 15 CFM/PERSON = 30

PEOPLE SMOKING x ____ CFM/PERSON = ____

CFM VENTILATION = ____

INFILTRATION

SWINGING REVOLVING DOORS ____ PEOPLE X ____ CFM/PERSON = ____

OPEN DOORS ____ DOOR X ____ CFM/DOOR = ____

EXHAUST FAN ____

CRACK ____ FEET X ____ CFM/FT = ____

CFM INFILTRATION

DEHUMIDIFIED AIR

(1 - ____ B. F.) X (____ F. RMT. - ____ F. APP. DP) = ____ F DEHUM RISE

1.08 X F DEHUMIDIFIER RISE = ROOM SENS. / ____ = ____ CFM

NOTES

OUTSIDE AIR @ 1 AIR CHANGE

OA = 2223 x 1/60 = 37 SAY 40 CFM

USE 40 CFM OUTSIDE AIR.

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A/C LOAD ESTIMATE

ROOM OFFICE SIZE 5X19 = 285 SF V = 2565 CF

ITEM	QUANTITY	DIFFERENCE	FACTOR	BTU PER HR
SUNLIGHT GAIN				
W GLASS	FT² x		B/FT²/HR =	
S GLASS	FT² x		B/FT²/HR x	
N GLASS	FT² x		B/FT²/HR x	
E GLASS	FT² x		B/FT²/HR x	
SKYLIGHT	FT² x		B/FT²/HR x	
ROOF	FT² x		B/FT²/HR x	
TRANSMISSION GAIN				
ALL GLASS	FT² x		°F x	
W WALL	72 FT² x	8	°F x 0.49	640
S WALL	FT² x		°F x	
N WALL	FT² x		°F x	
E WALL	FT² x		°F x	
PARTITION	71 FT² x	0	°F x 0.46	730
CEILING	285 FT² x	45	°F x 0.3	1370
FLOOR	FT² x		°F x	
INFILTRATION & OUTSIDE AIR				
INFILTR.	CFM x		°F x 1.08	
INTERNAL HEAT				
PEOPLE	2 PEOPLE x	215		430
MOTORS	HP x 746 x 3.4 x			
LIGHTS	3X285 WATTS x 3.4 x			2900
FLOOR				
ROOM SENSIBLE HEAT SUBTOTAL				6130
SAFETY FACTOR		10 %		615
ROOM SENSIBLE HEAT				6745
ROOM LATENT HEAT				
INFILTR.	CFM x	GR. Δ	x 0.68	
PEOPLE	2 PEOPLE x	235		470
STEAM	x	LB/HR	x 1000	
ROOM LATENT HEAT SUBTOTAL				
SAFETY FACTOR		10 %		50
ROOM LATENT HEAT				520
ROOM TOTAL HEAT				7265
OUTSIDE AIR HEAT				
S. H.	CFM x		°F x 1.08	
L. H.	CFM x		GR/H. x 0.68	
GRAND TOTAL HEAT SUBTOTAL				
TONS =	GRAND TOTAL HEAT			
SENS. HEAT FACTOR	ROOM SENS. / ROOM TOTAL			

ESTIMATES FOR AM PM PEAK

CONDITIONS	DB	WB	%RH	DP	GR PER LB
OUTSIDE					
ROOM					
DIFFERENCE					

VENTILATION

2 PEOPLE NOT SMOKING x 15 CFM/PERSON = 30

PEOPLE SMOKING x CFM/PERSON =

CFM VENTILATION =

INFILTRATION

SWINGING REVOLVING DOORS PEOPLE x CFM/PERSON =

OPEN DOORS DOOR x CFM/DOOR =

EXHAUST FAN

CRACK FEET x CFM/FT =

CFM INFILTRATION

DEHUMIDIFIED AIR

(1 - B. F.) x (F. RMT. - F. APP. DP) = F DEHUM INSR

ROOM SENS. / F DEHUMIDIFIER RISE = CFM

1.08 x

NOTES

OUTSIDE AIR @ 1 AIR CHANGE

OA = 2565 x 1/60 = 42.7 SAY 50 CFM

USE 50 CFM OUTSIDE AIR

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A/C LOAD ESTIMATE

ROOM OFFICE SIZE 16x19 = 304 SF V = 2736 CF

ITEM	QUANTITY	DIFFERENCE	FACTOR	BTU PER HR
SUNLIGHT GAIN				
W GLASS		FT² x	B/FT²/HR x	
S GLASS		FT² x	B/FT²/HR x	
N GLASS		FT² x	B/FT²/HR x	
E GLASS		FT² x	B/FT²/HR x	
SKYLIGHT		FT² x	B/FT²/HR x	
ROOF		FT² x	B/FT²/HR x	
TRANSMISSION GAIN				
ALL GLASS		FT² x	°F x	
W WALL		FT² x	°F x	
S WALL		FT² x	°F x	
PART	99	FT² x 25	°F x 0.41	1020
E WALL	45	FT² x 14	°F x 0.49	310
PARTITION	171	FT² x 25	°F x 0.41	1750
CEILING	304	FT² x 48	°F x 0.10	1460
FLOOR		FT² x	°F x	
INFILTRATION & OUTSIDE AIR				
INFILTR.		CFM x	°F x 1.08	
INTERNAL HEAT				
PEOPLE	2	PEOPLE x 215		430
MOTORS		HP x 746 x 3.4 x		
LIGHTS	3x3=4	WATTS x 3.4 x		3100
FLOOR				
ROOM SENSIBLE HEAT SUBTOTAL				8070
		SAFETY FACTOR 10 %		810
ROOM SENSIBLE HEAT				8880
ROOM LATENT HEAT				
INFILTR.		CFM x	GR/# x 0.68	
PEOPLE	2	PEOPLE x 235		470
STEAM		x	LB/HR # 1000	
ROOM LATENT HEAT SUBTOTAL				
		SAFETY FACTOR 10 %		50
ROOM LATENT HEAT				520
ROOM TOTAL HEAT				9400
OUTSIDE AIR HEAT				
S. H.		CFM x	°F x 1.08	
L. H.		CFM x	GR/H x 0.68	
GRAND TOTAL HEAT SUBTOTAL				
TONS =		GRAND TOTAL HEAT		
SENS HEAT FACTOR =		ROOM SENS. / ROOM TOTAL		

ESTIMATES FOR AM / PM PEAK

CONDITIONS	DB	WB	% RH	DP	GR PER LB
OUTSIDE					
ROOM					
DIFFERENCE					

VENTILATION

2 PEOPLE NOT SMOKING x 15 CFM/PERSON = 30

PEOPLE SMOKING x ____ CFM/PERSON = ____

CFM VENTILATION = ____

INFILTRATION

SWINGING REVOLVING DOORS ____ PEOPLE x ____ CFM/PERSON = ____

OPEN DOORS ____ DOOR x ____ CFM/DOOR = ____

EXHAUST FAN ____

CRACK ____ FEET x ____ CFM/FT = ____

CFM INFILTRATION

DEHUMIDIFIED AIR

(1 - ____ B. F.) x (____ F. RMT. - ____ F. APP. DP) = ____ F DEHUM RISE

1.08 x F DEHUMIDIFIER RISE = ROOM SENS. / ____ CFM

NOTES

OUTSIDE AIR @ 1 AIR CHANGE

OA = 2736 x 1/60 = 45.5 SAY 50 CFM

USE 50 CFM OUTSIDE AIR

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A/C LOAD ESTIMATE

ROOM EQUIPMENT ROOM SIZE 21X21 = 441 SF V = 3969 CF

ITEM	QUANTITY	DIFFERENCE	FACTOR	BTU PER HR
SUNLIGHT GAIN				
W GLASS	FT² x		B/FT²/HR x	
S GLASS	FT² x		B/FT²/HR x	
N GLASS	FT² x		B/FT²/HR x	
E GLASS	FT² x		B/FT²/HR x	
SKYLIGHT	FT² x		B/FT²/HR x	
ROOF	FT² x		B/FT²/HR x	
TRANSMISSION GAIN				
ALL GLASS	FT² x		°F x	
W WALL	FT² x		°F x	
S WALL	FT² x		°F x	
N WALL	FT² x		°F x	
E WALL	FT² x		°F x	
PARTITION	FT² x		°F x	
CEILING	441 FT² x	48	°F x 0.10	2110
FLOOR	FT² x		°F x	
INFILTRATION & OUTSIDE AIR				
INFILTR.	CFM x		°F x 1.08	
INTERNAL HEAT				
PEOPLE	PEOPLE x			
MOTORS	5 HP x 740 x 3.4 x			12700
LIGHTS	3X44 WATTS x 3.4 x			4500
FLOOR				
ROOM SENSIBLE HEAT SUBTOTAL				19310
SAFETY FACTOR	10 %			1931
ROOM SENSIBLE HEAT				21240
ROOM LATENT HEAT				
INFILTR.	CFM x	GR./#	x 0.68	
PEOPLE	PEOPLE x			
STEAM	x	LB/HR	x 1000	
ROOM LATENT HEAT SUBTOTAL				
SAFETY FACTOR	%			
ROOM LATENT HEAT				
ROOM TOTAL HEAT				21240
OUTSIDE AIR HEAT				
S. H.	CFM x	°F x 1.08		
L. H.	CFM x	GR/# x 0.68		
GRAND TOTAL HEAT SUBTOTAL				
TONS = GRAND TOTAL HEAT				
SENS HEAT FACTOR	ROOM SENS. / ROOM TOTAL			

ESTIMATES FOR AM / PM PEAK

CONDITIONS	DB	WB	% RH	DP	GR PER LB
OUTSIDE					
ROOM					
DIFFERENCE					

VENTILATION

PEOPLE NOT SMOKING ____ x ____ CFM/PERSON = ____

PEOPLE SMOKING ____ x ____ CFM/PERSON = ____

CFM VENTILATION = ____

INFILTRATION

SWINGING DOORS ____ PEOPLE x ____ CFM/PERSON = ____

OPEN DOORS ____ DOOR x ____ CFM/DOOR = ____

EXHAUST FAN ____

CRACK ____ FEET x ____ CFM/FT = ____

CFM INFILTRATION

DEHUMIDIFIED AIR

(1 - ____ S. E.) x (____ F. RMT. - ____ F. APP. DP) = ____ F. DEHUM RISE

1.03 x ROOM SENS. / F. DEHUMIDIFIER RISE = ____ CFM

NOTES

OUTSIDE AIR @ 1 AIR CHANGE

@ = 3969 CF x 1/60 = 66.6 SAY 70 CFM

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A/C LOAD ESTIMATE

ROOM VAULT AREA SIZE 12 x 19 = 228 SF V = 2052 CF

ITEM	QUANTITY	DIFFERENCE	FACTOR	BTU PER HR
SUNLIGHT GAIN				
W GLASS	FT² x		B/FT²/HR x	
S GLASS	FT² x		B/FT²/HR x	
N GLASS	FT² x		B/FT²/HR x	
E GLASS	FT² x		B/FT²/HR x	
SKYLIGHT	FT² x		B/FT²/HR x	
ROOF	FT² x		B/FT²/HR x	
TRANSMISSION GAIN				
ALL GLASS	FT² x		°F x	
W WALL	FT² x		°F x	
S WALL	FT² x		°F x	
N WALL	FT² x		°F x	
E WALL	FT² x		°F x	
PARTITION	108 FT² x	25	°F x 0.41	100
CEILING	228 FT² x	45	°F x 0.10	100
FLOOR	FT² x		°F x	
INFILTRATION & OUTSIDE AIR				
INFILTR.	CFM x		°F x 1.03	
INTERNAL HEAT				
PEOPLE	PEOPLE x			
MOTORS	HP x 746 x 3.4 x			
LIGHTS	3X225 WATTS x 3.4 x			2330
FLOOR				
ROOM SENSIBLE HEAT SUBTOTAL				4530
SAFETY FACTOR		0	%	450
ROOM SENSIBLE HEAT				4980
ROOM LATENT HEAT				
INFILTR.	CFM x	GR./#	x 0.68	
PEOPLE	PEOPLE x			
STEAM	x	LB/HR	# 1000	
ROOM LATENT HEAT SUBTOTAL				
SAFETY FACTOR			%	
ROOM LATENT HEAT				
ROOM TOTAL HEAT				4980
OUTSIDE AIR HEAT				
S. H.	CFM x		°F x 1.08	
L. H.	CFM x		GR/H x 0.68	
GRAND TOTAL HEAT SUBTOTAL				
TONS	GRAND TOTAL HEAT			
SENS HEAT FACTOR	ROOM SENS. / ROOM TOTAL			

ESTIMATES FOR AM / PM PEAK

CONDITIONS	DB	WB	% RH	DP	GR PER LB
OUTSIDE					
ROOM					
DIFFERENCE					

VENTILATION

____ PEOPLE NOT SMOKING x ____ CFM/PERSON = ____

____ PEOPLE SMOKING x ____ CFM/PERSON = ____

CFM VENTILATION =

INFILTRATION

SWINGING REVOLVING DOORS ____ PEOPLE x ____ CFM/PERSON = ____

OPEN DOORS ____ DOOR x ____ CFM/DOOR = ____

EXHAUST FAN ____

CRACK ____ FEET x ____ CFM/FT = ____

CFM INFILTRATION

DEHUMIDIFIED AIR

(1 - ____ B. F.) x (____ °F. RMT. - ____ °F. APP. DR) = ____ °F DEHUM RISE

1.08 x °F DEHUMIDIFIER RISE = ROOM SENS. / ____ = ____ CFM

NOTES

OUTSIDE AIR @ 1 AIR CHANGE

OA = 2052 x 1/60 = 34.3 CAN 40 CFM

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A/C LOAD ESTIMATE

ROOM OFFICE SIZE 13x21 = 399 SF V = 3591 CF

ITEM	QUANTITY	DIFFERENCE	FACTOR	BTU PER HR
SUNLIGHT GAIN				
W GLASS		FT² x	B/FT²/HR x	
S GLASS		FT² x	B/FT²/HR x	
N GLASS		FT² x	B/FT²/HR x	
E GLASS		FT² x	B/FT²/HR x	
SKYLIGHT		FT² x	B/FT²/HR x	
ROOF		FT² x	B/FT²/HR x	
TRANSMISSION GAIN				
ALL GLASS		FT² x	°F x	
W WALL		FT² x	°F x	
S WALL		FT² x	°F x	
N WALL		FT² x	°F x	
E WALL		FT² x	°F x	
PARTITION		FT² x	°F x	
CEILING	399	FT² x 23	°F x 0.10	1820
FLOOR		FT² x	°F x	
INFILTRATION & OUTSIDE AIR				
INFILTR.		CFM x	°F x 1.03	
INTERNAL HEAT				
PEOPLE	2	PEOPLE x 215		430
MOTORS		HP x 746 x 3.4 x		
LIGHTS	3x 399	WATTS x 3.4		4090
FLOOR				
ROOM SENSIBLE HEAT SUBTOTAL				6830
SAFETY FACTOR	0	%		690
ROOM SENSIBLE HEAT				7550
ROOM LATENT HEAT				
INFILTR.		CFM x	GR/# x 0.68	
PEOPLE	2	PEOPLE x 235		940
LIGHT		x	LE/HR x 1000	
ROOM LATENT HEAT SUBTOTAL				
SAFETY FACTOR	10	%		95
ROOM LATENT HEAT				1035
ROOM TOTAL HEAT				8585
OUTSIDE AIR HEAT				
S. H.		CFM x	°F x 1.08	
L. H.		CFM x	GR/H x 0.68	
GRAND TOTAL HEAT SUBTOTAL				
TONS =		GRAND TOTAL HEAT		
SENS HEAT FACTOR		ROOM SENS. / ROOM TOTAL =		

ESTIMATES FOR AM / PM PEAK

CONDITIONS	DB	WB	% RH	DP	GR PER LB
OUTSIDE					
ROOM					
DIFFERENCE					

VENTILATION

2 PEOPLE NOT SMOKING x 15 CFM/PERSON = 60

PEOPLE SMOKING x ____ CFM/PERSON = ____

CFM VENTILATION = ____

INFILTRATION

SWINGING REVOLVING DOORS ____ PEOPLE X ____ CFM/PERSON = ____

OPEN DOORS ____ DOOR X ____ CFM/DOOR = ____

EXHAUST FAN ____

CRACK ____ FEET X ____ CFM/FT = ____

CFM INFILTRATION

DEHUMIDIFIED AIR

(1 - ____ B. F.) x (____F. RMT. - ____F. APP. DP) = ____ F. DEHUM RISE

ROOM SENS. / 1.08 x F. DEHUM RISE = ____ CFM

NOTES

OUTSIDE AIR & AIR CHANGE

7550 / 60 = 60 CFM APPROX.

USE 60 CFM OUTSIDE AIR

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[redacted]

A/C LOAD ESTIMATE

ROOM "E" SIZE 30x39 = 1140 SF V = 10,260 CF

ITEM	QUANTITY	DIFFERENCE	FACTOR	BTU PER HR
SUNLIGHT GAIN				
W GLASS	FT² x		B/FT²/HR x	
S GLASS	FT² x		B/FT²/HR x	
N GLASS	FT² x		B/FT²/HR x	
E GLASS	FT² x		B/FT²/HR x	
SKYLIGHT	FT² x		B/FT²/HR x	
ROOF	FT² x		B/FT²/HR x	
TRANSMISSION GAIN				
ALL GLASS	FT² x		°F x	
W WALL	360 FT² x	18	°F x 0.26	1685
S WALL	297 FT² x	16	°F x 0.26	1240
N WALL	54 FT² x	10	°F x 0.26	490
E WALL	FT² x		°F x	
PARTITION	FT² x		°F x	
CEILING	1140 FT² x	23	°F x 0.10	5470
FLOOR	FT² x		°F x	
INFILTRATION & OUTSIDE AIR				
INFILTR.	CFM x		°F x 1.08	
INTERNAL HEAT				
PEOPLE	PEOPLE x 215			215
MOTORS	HP x 746 x 3.4 x			
LIGHTS 2 X 40	WATTS x 3.4 x			11600
~~FLOOR~~ EQUIPMENT LOAD				7500
ROOM SENSIBLE HEAT SUBTOTAL				55695
SAFETY FACTOR 10 %				9570
ROOM SENSIBLE HEAT				105265
ROOM LATENT HEAT				
INFILTR.	CFM x	GR./#	x 0.68	
PEOPLE	PEOPLE x 235			235
STEAM	x	LB/HR	# 1000	
ROOM LATENT HEAT SUBTOTAL				
SAFETY FACTOR 10 %				25
ROOM LATENT HEAT				260
ROOM TOTAL HEAT				105525
OUTSIDE AIR HEAT				
S. H.	CFM x	°F	x 1.08	
L. H.	CFM x	GR/H	x 0.68	
GRAND TOTAL HEAT SUBTOTAL				
TONS = GRAND TOTAL HEAT				
SENS HEAT FACTOR ROOM SENS. / ROOM TOTAL				

ESTIMATES FOR AM / PM PEAK

CONDITIONS	DB	WB	%RH	DP	GR PER LB
OUTSIDE					
ROOM					
DIFFERENCE					

VENTILATION

PEOPLE NOT SMOKING x 15 CFM/PERSON = 15

PEOPLE SMOKING x ____ CFM/PERSON = ____

CFM VENTILATION =

INFILTRATION

SWINGING / REVOLVING DOORS ____ PEOPLE x ____ CFM/PERSON = ____

OPEN DOORS ____ DOOR x ____ CFM/DOOR = ____

EXHAUST FAN ____

CRACK ____ FEET x ____ CFM/FT = ____

CFM INFILTRATION

DEHUMIDIFIED AIR

(1 - ____ B. F.) x (____ F. RMT. - ____ F. APP. DP) = ____ F DEHUM RISE

ROOM SENS. = ____ CFM

1.08 x F DEHUMIDIFIER RISE

NOTES

OUTSIDE AIR = 1 AIR CHANGE

OA = 10,260 x 1/60 = 170 CFM APPROX

USE 170 CFM OUTSIDE AIR

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[redacted]

ROOM "A" SIZE AREA = 1385F V = 10,420 CF

ITEM	QUANTITY	DIFFERENCE	FACTOR	BTU PER HR
SUNLIGHT GAIN				
W GLASS		FT² x	B/FT²/HR x	
S GLASS		FT² x	B/FT²/HR x	
N GLASS		FT² x	B/FT²/HR x	
E GLASS		FT² x	B/FT²/HR x	
SKYLIGHT		FT² x	B/FT²/HR x	
ROOF		FT² x	B/FT²/HR x	
TRANSMISSION GAIN				
ALL GLASS		FT² x	°F x	
W WALL	360	FT² x 8	°F x 0.49	3170
S WALL		FT² x	°F x	
N WALL		FT² x	°F x	
E WALL		FT² x	°F x	
PARTITION		FT² x	°F x	
CEILING	390	FT² x 48	°F x 0.10	6620
FLOOR		FT² x	°F x	
INFILTRATION & OUTSIDE AIR				
INFILTR.		CFM x	°F x 1.03	
INTERNAL HEAT				
PEOPLE	2	PEOPLE x 215		430
MOTORS		HP x 746 x 3.4 x		
LIGHTS	3 x 380	WATTS x 3.4 x		14100
~~FLOOR~~ EQUIPMENT LOAD				59640
ROOM SENSIBLE HEAT SUBTOTAL				84180
		SAFETY FACTOR 10 %		8420
ROOM SENSIBLE HEAT				92580
ROOM LATENT HEAT				
INFILTR.		CFM x	GR./# x 0.68	
PEOPLE	2	PEOPLE x 235		470
STEAM		x	LB/HR #/1000	
ROOM LATENT HEAT SUBTOTAL				
		SAFETY FACTOR 10 %		50
ROOM LATENT HEAT				520
ROOM TOTAL HEAT				93100
OUTSIDE AIR HEAT				
S. H.		CFM x	°F x 1.09	
L. H.		CFM x	GR/H x 0.68	
GRAND TOTAL HEAT SUBTOTAL				
TONS =		GRAND TOTAL HEAT		
SENS HEAT FACTOR =		ROOM SENS. / ROOM TOTAL =		

ESTIMATES FOR AM PM PEAK

CONDITIONS	DB	WB	% RH	DP	GR PER LB
OUTSIDE					
ROOM					
DIFFERENCE					

VENTILATION

2 PEOPLE NOT SMOKING x 15 CFM/PERSON = 30

PEOPLE SMOKING x ____ CFM/PERSON = ____

CFM VENTILATION = ____

INFILTRATION

SWINGING REVOLVING DOORS ____ PEOPLE X ____ CFM/PERSON = ____

OPEN DOORS ____ DOOR X ____ CFM/DOOR = ____

EXHAUST FAN ____

CRACK ____ FEET X ____ CFM/FT = ____

CFM INFILTRATION

DEHUMIDIFIED AIR

(1 - ____ B. F.) X (____ F. RMT. - ____ F. APP. DP) = ____ F DEHUM RISE

ROOM SENS. / 1.08 x F DEHUMIDIFIER RISE = ____ CFM

NOTES

OUTSIDE AIR @ 1 AIR CHANGE

CA = 10,420 x 1/12 = 174 SAY 180 CFM

USE 180 CFM OUTSIDE AIR

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A/C LOAD ESTIMATE

ROOM "E" SIZE AREA = 820 SF V = 7560 CF

ITEM	QUANTITY	DIFFERENCE	FACTOR	BTU PER HR
SUNLIGHT GAIN				
W GLASS		FT² x	B/FT²/HR x	
S GLASS		FT² x	B/FT²/HR x	
N GLASS		FT² x	B/FT²/HR x	
E GLASS		FT² x	B/FT²/HR x	
SKYLIGHT		FT² x	B/FT²/HR x	
ROOF		FT² x	B/FT²/HR x	
TRANSMISSION GAIN				
ALL GLASS		FT² x	°F x	
W WALL	50	FT² x 18	°F x 0.42	2230
S WALL		FT² x	°F x	
N WALL		FT² x	°F x	
PART	20	FT² x 5	°F x 0.16	415
PARTITION	260	FT² x 25	°F x 0.41	2660
CEILING	820	FT² x 46	°F x 0.10	3530
FLOOR		FT² x	°F x	
INFILTRATION & OUTSIDE AIR				
INFILTR.		CFM x	°F x 1.03	
INTERNAL HEAT				
PEOPLE		PEOPLE x 215		215
MOTORS		HP x 746 x 3.4 x		
LIGHTS	3x820	WATTS x 3.4		5360
~~FLOOR~~ EQUIPMENT LOAD				6810
ROOM SENSIBLE HEAT SUBTOTAL				21610
		SAFETY FACTOR 10 %		2460
ROOM SENSIBLE HEAT				27100
ROOM LATENT HEAT				
INFILTR.		CFM x GR./#	x 0.68	
PEOPLE		PEOPLE x 235		235
STEAM		x LB/HR	= 1000	
ROOM LATENT HEAT SUBTOTAL				
		SAFETY FACTOR 10		23
ROOM LATENT HEAT				2-9
ROOM TOTAL HEAT				27360
OUTSIDE AIR HEAT				
S. H.		CFM x	°F x 1.08	
L. H.		CFM x	GR/# x 0.68	
GRAND TOTAL HEAT SUBTOTAL				
TONS =		GRAND TOTAL HEAT		
SENS HEAT FACTOR		ROOM SENS. / ROOM TOTAL		

ESTIMATES FOR	AM / PM PEAK				
CONDITIONS	DB	WB	% RH	DP	GR PER LB
OUTSIDE					
ROOM					
DIFFERENCE					

VENTILATION

1 PEOPLE NOT SMOKING x 15 CFM/PERSON = 15

___ PEOPLE SMOKING x ___ CFM/PERSON = ___

TOTAL VENTILATION =

INFILTRATION

SWINGING / REVOLVING DOORS ___ PEOPLE X ___ CFM/PERSON = ___

OPEN DOORS ___ DOOR X ___ CFM/DOOR = ___

EXHAUST FAN ___ = ___

CRACK ___ FEET X ___ CFM/FT = ___

CFM INFILTRATION

DEHUMIDIFIED AIR

(1 - ___ R.F.) x (___ F. R.H. - ___ F. APP. DP) = ___ F. DEHUM. RISE

1.03 x ROOM SENS. / F. DEHUMID. RISE = ___ CFM

NOTES

OUTSIDE AIR = 1 AIR CHANGE

CFM = 820 x 3 1/2 SAY 125 CFM

USE 150 CFM OUTSIDE AIR

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A/C LOAD ESTIMATE

ROOM "C" SIZE 19x2 = 399 SF V = 3591 CF

ITEM	QUANTITY	DIFFERENCE	FACTOR	BTU PER HR
SUNLIGHT GAIN				
W GLASS		FT² x	B/FT²/HR x	
S GLASS		FT² x	B/FT²/HR x	
N GLASS		FT² x	B/FT²/HR x	
E GLASS		FT² x	B/FT²/HR x	
SKYLIGHT		FT² x	B/FT²/HR x	
ROOF		FT² x	B/FT²/HR x	
TRANSMISSION GAIN				
ALL GLASS		FT² x	°F x	
W WALL		FT² x	°F x	
S WALL		FT² x	°F x	
N WALL		FT² x	°F x	
E WALL		FT² x	°F x	
PARTITION		FT² x	°F x	
CEILING	399	FT² x [illegible]	°F x 5 0	9201
FLOOR		FT² x	°F x	
INFILTRATION & OUTSIDE AIR				
INFILTR.		CFM x	°F x 1.09	
INTERNAL HEAT				
PEOPLE		PEOPLE x 2 1 2		215
MOTORS		HP x 746 x 3.4 x		
LIGHTS	2x2	WATTS x 3.4 x		4080
~~FLOOR~~ EQUIPMENT LOAD				14690
ROOM SENSIBLE HEAT SUBTOTAL				20305
		SAFETY FACTOR 10 %		2030
ROOM SENSIBLE HEAT				22335
ROOM LATENT HEAT				
INFILTR.		CFM x GR./#	x 0.69	
PEOPLE		PEOPLE x 235		235
STEAM		x LB/HR	x 1000	
ROOM LATENT HEAT SUBTOTAL				
		SAFETY FACTOR 10 %		25
ROOM LATENT HEAT				260
ROOM TOTAL HEAT				23295
OUTSIDE AIR HEAT				
S. H.		CFM x	°F x 1.09	
L. H.		CFM x	GR/H x 0.68	
GRAND TOTAL HEAT SUBTOTAL				
TONS = GRAND TOTAL HEAT				
SENS HEAT FACTOR = ROOM SENS. / ROOM TOTAL				

ESTIMATES FOR AM / PM **PEAK**

CONDITIONS	DB	WB	%RH	DP	GR PER LB
OUTSIDE					
ROOM					
DIFFERENCE					

VENTILATION

PEOPLE NOT SMOKING x 15 CFM/PERSON = 15

PEOPLE SMOKING x ____ CFM/PERSON = ____

CFM VENTILATION =

INFILTRATION

FACING NO. REVOLVING DOORS ____ PEOPLE x ____ CFM/PERSON = ____

OPEN DOORS ____ DOOR x ____ CFM/DOOR = ____

EXHAUST FAN ____

CRACK ____ FEET x ____ CFM/FT = ____

CFM INFILTRATION

DEHUMIDIFIED AIR

(1 - ____ B. F.) x (____ F. RMT. - ____ F. APP. DP) = ____ F. DEHUM

1.08 x F. DEHUMIDIFIER RISE = ROOM SENS. / ____ = ____ CFM

NOTES

OUTSIDE AIR @ 1 AIR CHANGE

OA = 3591 x 1/60 = 60 CFM APPROX.

USE 60 CFM OUTSIDE AIR

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A/C LOAD ESTIMATE

ROOM "C2" SIZE 24x43=1032SF V=9288 CF

ITEM	QUANTITY	DIFFERENCE	FACTOR	BTU PER HR
SUNLIGHT GAIN				
W GLASS		FT² x	B/FT²/HR x	
S GLASS		FT² x	B/FT²/HR x	
N GLASS		FT² x	B/FT²/HR x	
E GLASS		FT² x	B/FT²/HR x	
SKYLIGHT		FT² x	B/FT²/HR x	
ROOF		FT² x	B/FT²/HR x	
TRANSMISSION GAIN				
ALL GLASS		FT² x	°F x	
W WALL		FT² x	°F x	
S WALL		FT² x	°F x	
N WALL	387	FT² x 10	°F x 0.49	1850
E WALL	216	FT² x 14	°F x 0.49	1490
PARTITION		FT² x	°F x	
CEILING	1032	FT² x 20	°F x 0.19	4350
FLOOR		FT² x	°F x	
INFILTRATION & OUTSIDE AIR				
INFILTR.		CFM x	°F x 1.08	
INTERNAL HEAT				
PEOPLE	4	PEOPLE x 225		840
MOTORS		HP x 746 x 3.4 x		
LIGHTS	2x1032	WATTS x 3.4 x		10509
~~FLOOR~~ EQUIPMENT LOAD				65277
ROOM SENSIBLE HEAT SUBTOTAL				83075
		SAFETY FACTOR 10 %		8508
ROOM SENSIBLE HEAT				76825
ROOM LATENT HEAT				
INFILTR.		CFM x GR/#	x 0.68	
PEOPLE	4	PEOPLE x 235		940
STEAM		x LB/HR	# 1000	
ROOM LATENT HEAT SUBTOTAL				
		SAFETY FACTOR 10 %		95
ROOM LATENT HEAT				1035
ROOM TOTAL HEAT				77860
OUTSIDE AIR HEAT				
S. H.		CFM x	°F x 1.08	
L. H.		CFM x	GR/H x 0.68	
GRAND TOTAL HEAT SUBTOTAL				
TONS=		GRAND TOTAL HEAT		
SENS HEAT FACTOR		ROOM SENS. / ROOM TOTAL		

ESTIMATES FOR AM / PM PEAK

CONDITIONS	DB	WB	%RH	DP	GR PER LB
OUTSIDE					
ROOM					
DIFFERENCE					

VENTILATION

4 PEOPLE NOT SMOKING x 15 CFM/PERSON = 60

____ PEOPLE SMOKING x ____ CFM/PERSON = ____

CFM VENTILATION =

INFILTRATION

SWINGING REVOLVING DOORS ___ PEOPLE X ____ CFM/PERSON = ____

OPEN DOORS ____ DOOR X ____ CFM/DOOR = ____

EXHAUST FAN ____

CRACK ____ FEET X ____ CFM/FT = ____

CFM INFILTRATION

DEHUMIDIFIED AIR

(1 - ____ B. F.) X (___ F. RMT. - ___ F. APP. DP) = ___ F DEHUM RISE

1.08 x (ROOM SENS. / F DEHUMIDIFIER RISE) = ____ CFM

NOTES

OUTSIDE AIR @ 1 AIR CHANGE

OA = 9288 ÷ 60 = 154. SAY 160 CFM

USE 160 CFM OUTSIDE AIR

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A/C LOAD ESTIMATE

ROOM C3" SIZE 21x24 = 504 SF V = 4536 CF

ITEM	QUANTITY	DIFFERENCE	FACTOR	BTU PER HR
SUNLIGHT GAIN				
W GLASS		FT² x	B/FT²/HR x	
S GLASS		FT² x	B/FT²/HR x	
N GLASS		FT² x	B/FT²/HR x	
E GLASS		FT² x	B/FT²/HR x	
SKYLIGHT		FT² x	B/FT²/HR x	
ROOF		FT² x	B/FT²/HR x	
TRANSMISSION GAIN				
ALL GLASS		FT² x	°F x	
W WALL		FT² x	°F x	
S WALL		FT² x	°F x	
N WALL		FT² x	°F x	
E WALL	89	FT² x R	°F x 0.49	1300
PARTITION		FT² x	°F x	
CEILING	504	FT² x 45	°F x 0.10	2420
FLOOR		FT² x	°F x	
INFILTRATION & OUTSIDE AIR				
INFILTR.		CFM x	°F x 1.08	
INTERNAL HEAT				
PEOPLE	3	PEOPLE x 215		645
MOTORS		HP x 746 x 3.4 x		
LIGHTS	3x500	WATTS x 3.4 x		5150
FLOOR	EQUIPMENT LOAD			21420
ROOM SENSIBLE HEAT SUBTOTAL				30835
SAFETY FACTOR		10 %		3083
ROOM SENSIBLE HEAT				34030
ROOM LATENT HEAT				
INFILTR.		CFM x	GR/# x 0.68	
PEOPLE	2	PEOPLE x 235		705
STEAM		x LB/HR	÷ 1000	
ROOM LATENT HEAT SUBTOTAL				
SAFETY FACTOR		10 %		70
ROOM LATENT HEAT				775
ROOM TOTAL HEAT				34805
OUTSIDE AIR HEAT				
S. H.		x	°F x 1.08	
L. H.		CFM x	GR/H x 0.68	
GRAND TOTAL HEAT SUBTOTAL				
TONS =		GRAND TOTAL HEAT		
SENS HEAT FACTOR =		ROOM SENS. / ROOM TOTAL		

ESTIMATES FOR AM / PM PEAK

CONDITIONS	DB	WB	% RH	DP	GR PER LB
OUTSIDE					
ROOM					
DIFFERENCE					

VENTILATION

3 PEOPLE NOT SMOKING x 15 CFM/PERSON = 45

PEOPLE SMOKING x ____ CFM/PERSON = ____

CFM VENTILATION = ____

INFILTRATION

SWINGING, REVOLVING DOORS ____ PEOPLE x ____ CFM/PERSON = ____

OPEN DOORS ____ DOOR x ____ CFM/DOOR = ____

EXHAUST FAN ____

CRACK ____ FEET x ____ CFM/FT = ____

CFM INFILTRATION

DEHUMIDIFIED AIR

(g - ____ g. r.) x (____ F. RMT. - ____ F. APP. DP) = ____ F DEHUM RISE

ROOM SENS. / 1.08 x F DEHUMIDIFIER RISE = ____ CFM

NOTES

OUTSIDE AIR @ 1 AIR CHANGE

OA = 4536 x 1/60 = 75.6 SAY 60 CFM

USE 60 CFM OUTSIDE AIR

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A/C LOAD ESTIMATE

ROOM #D4 SIZE AREA=2290SF V=20,610 CF

ITEM	QUANTITY	DIFFERENCE	FACTOR	BTU PER HR
SUNLIGHT GAIN				
W GLASS	FT² x		B/FT²/HR x	
S GLASS	FT² x		B/FT²/HR x	
N GLASS	FT² x		B/FT²/HR x	
E GLASS	FT² x		B/FT²/HR x	
SKYLIGHT	FT² x		B/FT²/HR x	
ROOF	FT² x		B/FT²/HR x	
TRANSMISSION GAIN				
ALL GLASS	FT² x		°F x	
W WALL	FT² x		°F x	
S WALL	FT² x		°F x	
N WALL	FT² x		°F x	
E WALL	FT² x		°F x	
PARTITION	720 FT² x	25	°F x 0.41	7380
CEILING	2290 FT² x	48	°F x 0.10	11000
FLOOR	FT² x		°F x	
INFILTRATION & OUTSIDE AIR				
INFILTR.	CFM x		°F x 1.08	
INTERNAL HEAT				
PEOPLE	6 PEOPLE x	215		1290
MOTORS	HP x 745 x 3.4 x			
LIGHTS	3X2200 WATTS x 3.4 x			23400
FLOOR	EQUIPMENT LOAD *			39600
ROOM SENSIBLE HEAT SUBTOTAL				334470
	SAFETY FACTOR 10 %			33550
ROOM SENSIBLE HEAT				368020
ROOM LATENT HEAT				
INFILTR.	CFM x	GR./#	x 0.68	
PEOPLE	6 PEOPLE x	235		1410
STEAM	x	LB/HR	# 1060	
ROOM LATENT HEAT SUBTOTAL				
	SAFETY FACTOR 10 %			140
ROOM LATENT HEAT				550
ROOM TOTAL HEAT				370570
OUTSIDE AIR HEAT				
S. H.	CFM x		°F x 1.08	
L. H.	CFM x		GR/H x 0.68	
GRAND TOTAL HEAT SUBTOTAL				
TONS=	GRAND TOTAL HEAT			
SENS. HEAT FACTOR	ROOM SENS. / ROOM TOTAL			

ESTIMATES FOR AM / PM PEAK

CONDITIONS	DB	WB	% RH	DP	GR PER LB
OUTSIDE					
ROOM					
DIFFERENCE					

VENTILATION

6 PEOPLE NOT SMOKING x 15 CFM/PERSON = 90

PEOPLE SMOKING x CFM/PERSON =

CFM VENTILATION =

INFILTRATION

SWINGING / REVOLVING DOORS PEOPLE x CFM/PERSON =

OPEN DOORS DOOR x CFM/DOOR =

EXHAUST FAN

CRACK FEET x CFM/FT

CFM INFILTRATION

DEHUMIDIFIED AIR

(T° R.F.) x (F. RMT. − F. APP. DP) = F DEHUM RISE

ROOM SENS. / 1.08 x F DEHUMIDIFIER RISE = CFM

NOTES

OUTSIDE AIR @ 1 AIR CHANGE

CFM = 20,610 x 1/60 = 344 SAY 350 CFM

USE 350 CFM OUTSIDE AIR

* POSSIBLE FUTURE EMERGENCY LOAD OF 62,900 BTUH INCLUDED

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A/C LOAD SUMMARY

AT NORMAL OPERATION

AHU-1 SUPPLIES: ROOMS A, B, C1, C2, C3 & OFFICES.
AHU-2 STAND-BY, SUPPLIES: ROOMS A, B, C1, C2 & C3.
AHU-3 SUPPLIES: ROOM E.
AHU-4 & AHU-5 SUPPLIES: ROOM D.

a. FOR AHU-1

ROOM	RSH, BTUH	RLH, BTUH	RTH, BTUH	OA, CFM
RECEPTION & LOUNGE ROOM	14,600	1,035	15,635	60
OFFICE	8,325	1,035	9,360	60
OFFICE	7,705	520	8,225	40
OFFICE	6,745	520	7,265	50
OFFICE	8,880	520	9,400	50
EQUIP. ROOM	21,240	-	21,240	70
VAULT AREA	4,980	-	4,980	40
OFFICE	7,550	1,035	8,585	60
A	92,580	520	93,100	180
B	27,100	260	27,360	130
C1	22,995	260	23,255	60
C2	96,825	1,035	97,860	160
C3	34,030	775	34,805	80
TOTALS =	353,555	7,515	361,070	1,040

b. FOR AHU-2

A	92,580	520	93,100	180
B	27,100	260	27,360	130
C1	22,995	260	23,255	60
C2	96,825	1,035	97,860	160
C3	34,030	775	34,805	80
TOTALS =	273,530	2,850	276,380	610

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A/C LOAD SUMMARY (CONT.)

c. FOR AHU-3

ROOM	RSH, BTUH	RLH, BTUH	RTH, BTUH	OA, CFM
E	105,265	260	105,525	170

d. FOR AHU-4 & AHU-5

D	369,020	1,550	370,570	350

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A/C LOAD CALCULATION (AHU-1 BLOW THRU SYSTEM MULTI-ZONE)

1. RSH = 353,555 BTUH
2. RLH = 7,515 BTUH
3. RTH = 361,070 BTUH
4. TOTAL OUTSIDE AIR, OA = 1,040 CFM
5. OASH = 1,040 × 1.08 × 15 = 16,800 BTUH
6. OALH = 1,040 × 0.68 × 56 = 39,500 BTUH
7. OATH = 16,800 + 39,500 = 56,300 BTUH
8. HEAT GAIN THRU FAN MOTOR
   ASSUME 10 HP MOTOR
   FMSH = 10 × 2545 = 25,450 BTUH
9. GRAND TOTAL HEAT LOAD
   GTHL = 361,070 + 56,300 + 25,450
   = 442,820 BTUH
10. COIL CONDITIONS
   ASSUME 10% BY-PASS FACTOR
   a. ERSH = 353,555 + 0.10 (16,800 + 25,450)
   = 357,780 BTUH
   b. ERLH = 7,515 + 0.10 × 39,500
   = 11,465 BTUH
   c. ERTH = 357,780 + 11,465
   = 369,245 BTUH
   d. ESHF = $\frac{357,780}{369,245}$ = 0.97
   e. APPARATUS DEW POINT = 57.6 °F
   f. SUPPLY AIR, SA = $\frac{357,780}{1.08 \times (1-0.10) \times (78-57.6)}$
   = 18,000 CFM

g. RETURN AIR, RA = 18,000 − 1,040
= 16,960 CFM

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A/C LOAD CALCULATION (CONT)

h. MIXED AIR CONDITION

$$T_M = \frac{93 \times 1040 + 78 \times 16,960}{18,000} = 79\ ^\circ F$$

i. ENTERING AIR CONDITION

$T_{EDB} = 79\ ^\circ FDB$

$T_{EWB} = 66.1\ ^\circ FWB$

$h_E = 30.8\ BTU/LB$

j. LEAVING AIR CONDITION

$T_{LDB} = 79 - (79 - 57.6)(1 - 0.10)$

$= 59.7\ ^\circ FDB$

$T_{LWB} = 58.4\ ^\circ FWB$

$h_L = 25.4\ BTU/LB$

K. GRAND TOTAL HEAT LOAD

$GTHL = 18,000 \times 4.45 \times (30.8 - 25.4)$

$= 434,000\ BTUH$

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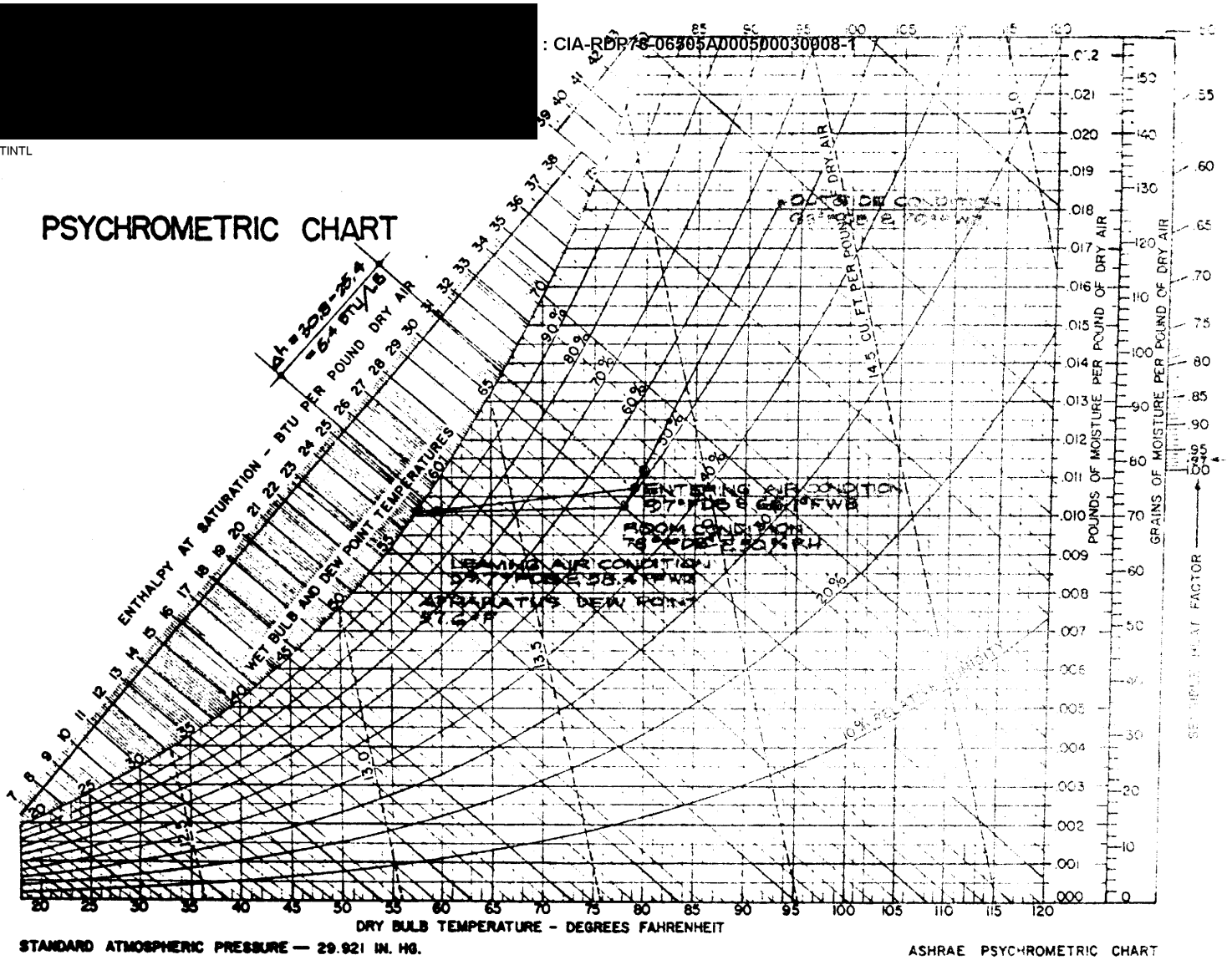
PSYCHROMETRIC CHART


ENTHALPY AT SATURATION - BTU PER POUND DRY AIR
WET BULB AND DEW POINT TEMPERATURES
DRY BULB TEMPERATURE - DEGREES FAHRENHEIT
POUNDS OF MOISTURE PER POUND OF DRY AIR
GRAINS OF MOISTURE PER POUND OF DRY AIR
SENSIBLE HEAT FACTOR
VOLUME CU. FT. PER POUND DRY AIR
RELATIVE HUMIDITY
ENTERING AIR CONDITION
FROM CONDITION
LEAVING AIR CONDITION
APPARATUS DEW POINT

STANDARD ATMOSPHERIC PRESSURE — 29.921 IN. HG.

ASHRAE PSYCHROMETRIC CHART

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SUPPLY AIR

$$\text{SUPPLY AIR FACTOR} = \frac{18,000}{357,780} = 0.051 \text{ APPROX.}$$

DESIGNATION	RSH, BTUH	SA, CFM
RECEPTION & LOUNGE ROOM	14,600	750
OFFICE	8,325	450
OFFICE	7,765	400
OFFICE	6,745	350
OFFICE	8,880	450
EQUIP. ROOM	21,240	1100
VAULT AREA	4,980	250
OFFICE	7,550	400
	SUB-TOTAL =	4150
A	92,580	4700
B	27,100	1400
C1	22,995	1200
C2	96,825	4850
C3	34,030	1700
	SUB-TOTAL =	13,850
	TOTAL =	18,000

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A/C LOAD CALCULATION (AHU-2 DRAW-THRU SYSTEM)

1. RSH = 273,530 BTUH
2. RLH = 2,850 BTUH
3. RTH = 276,380 BTUH
4. TOTAL OUTSIDE AIR, OA = 610 CFM
5. OASH = 610 × 1.08 × 15 = 9,900 BTUH
6. OALH = 610 × 0.68 × 56 = 23,200 BTUH
7. OATH = 9,900 + 23,200 = 33,100 BTUH
8. FAN MOTOR HEAT GAIN, REF G FI-III TABLE 45
   ASSUME STATIC PRESSURE = 1½" WG & 20°F TEMPERATURE DIFFERENCE BETWEEN ROOM & SUPPLY AIR.
   FMSH = 0.030 × 273,530 = 8,200 BTUH
9. GRAND TOTAL HEAT LOAD
   GTHL = 276,380 + 33,100 + 8,200
   = 317,680 BTUH
10. COIL CONDITIONS
    ASSUME 10% BY-PASS FACTOR
    a. ERSH = 273,530 + 8200 + 0.10 × 9,900
    = 282,720 BTUH
    b. ERLH = 2,850 + 0.10 × 23,200
    = 5,170 BTUH
    c. ERTH = 282,720 + 5,170
    = 287,890 BTUH
    d. SUPPLY AIR = 13,850 CFM (SEE SHEET NO. 24)
    e. RETURN AIR = 13,850 - 610 = 13,240 CFM

f. APPARATUS DEW POINT

$$ADP = 78 - \frac{282,720}{1.08 \times (1-0.10) \times 13,850} = 57°F$$

g. MIXED AIR CONDITION

$$T_M = \frac{93 \times 610 + 78 \times 13,240}{13,850} = 78.8°F$$

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h. ENTERING AIR CONDITION

$T_{EDB} = 78.8°F DB$

$T_{EWB} = 65.9°F WB$

$h_E = 30.7$ BTU/LB

i. LEAVING AIR CONDITION

$T_{LDB} = 78.8 - (78.8-57)(1-0.10)$

$= 59.2°F DB$

$T_{LWB} = 58.1°F WB$

$h_L = 25.2$ BTU/LB

j. GRAND TOTAL HEAT LOAD

$GTHL = 13,850 \times 4.45 \times (30.7-25.2)$

$= 339,000$ BTUH

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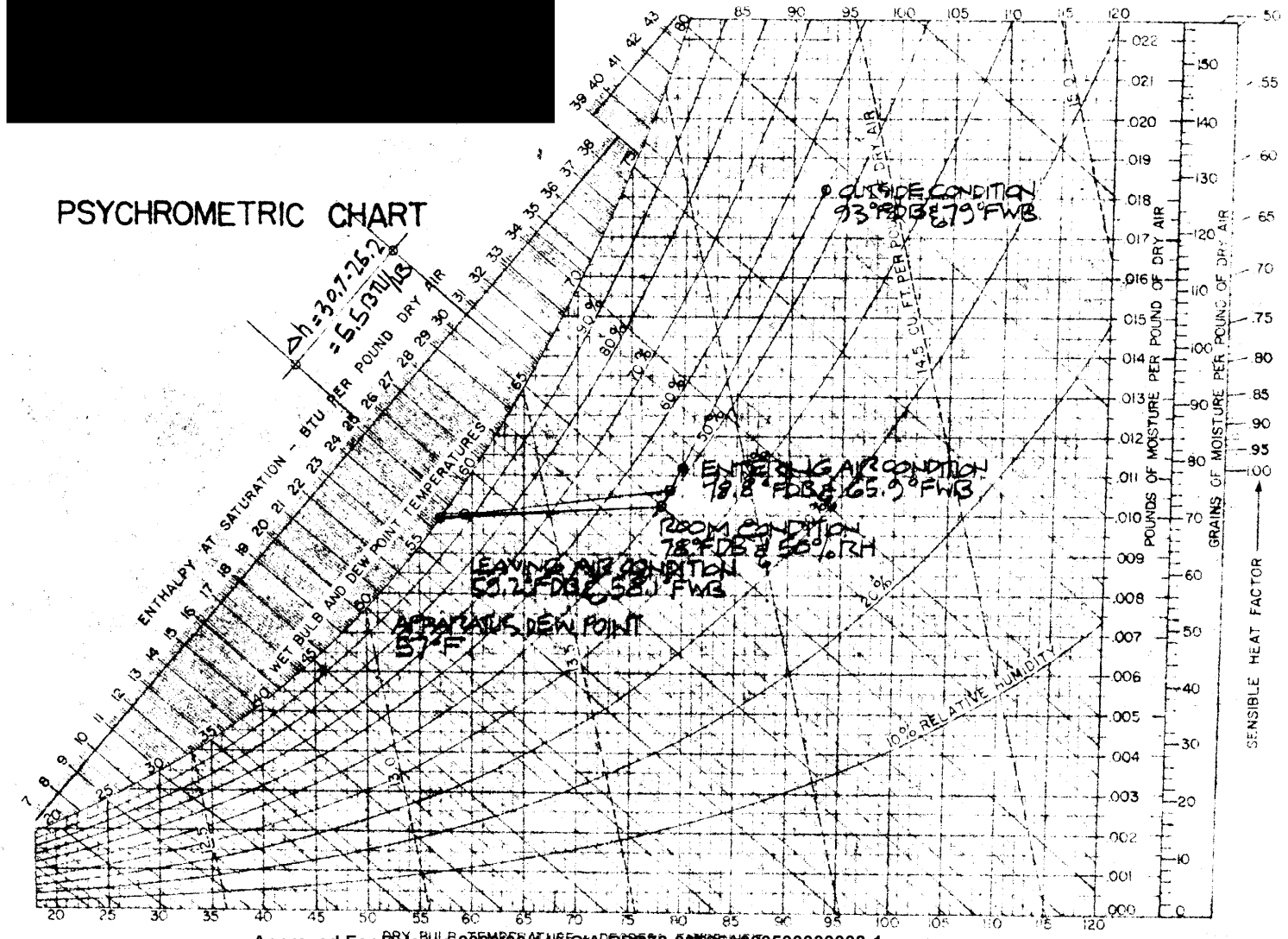
PSYCHROMETRIC CHART
Δh = 30.7 - 26.2
= 5.5 BTU/LB
OUTSIDE CONDITION
93°F DB & 79°F WB
ENTERING AIR CONDITION
78.8°F DB & 65.9°F WB
ROOM CONDITION
78°F DB & 50% RH
LEAVING AIR CONDITION
50.2°F DB & 58.1°F WB
APPARATUS DEW POINT
57°F
ENTHALPY AT SATURATION - BTU PER POUND DRY AIR
WET BULB AND DEW POINT TEMPERATURES
DRY BULB TEMPERATURE - DEGREES FAHRENHEIT
POUNDS OF MOISTURE PER POUND OF DRY AIR
GRAINS OF MOISTURE PER POUND OF DRY AIR
SENSIBLE HEAT FACTOR
14.5 CU FT PER POUND DRY AIR
10% RELATIVE HUMIDITY

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ASHRAE PSYCHROMETRIC CHART

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A/C LOAD CALCULATION (AHU-3 DRAW-THRU SYSTEM)

1. RSH = 105,265 BTUH
2. RLH = 260 BTUH
3. RTH = 105,525 BTUH
4. OUTSIDE AIR, OA = 170 CFM
5. OASH = 170 x 1.08 x 15 = 2,750 BTUH
6. OALH = 170 x 0.68 x 56 = 6,480 BTUH
7. OATH = 2750 + 6480 = 9,230 BTUH
8. HEAT GAIN THRU FAN MOTOR
   ASSUME STATIC PRESSURE = 1¼" WG & 20°F TEMPERATURE DIFFERENCE BETWEEN ROOM & SUPPLY AIR
   FMSH = 0.025 x 105,265 = 2,630 BTUH
9. GRAND TOTAL HEAT LOAD
   GTHL = 105,525 + 9,230 + 2,630
   = 117,385 BTUH
10. COIL CONDITIONS
   ASSUME 10% BY-PASS FACTOR
   a. ERSH = 105,265 + 2,630 + (0.10 x 2750)
   = 108,170 BTUH
   b. ERLH = 260 + (0.10 x 6480)
   = 910 BTUH
   c. ERTH = 108,170 + 910
   = 109,080 BTUH
   d. ESHF = $\frac{108,170}{109,080}$ = 0.99

e. APPARATUS DEW POINT = 57.8°F

f. SUPPLY AIR, SA = $\frac{108,170}{1.08 \times (1-0.10) \times (78-57.8)}$

SA = 5,500 CFM

g. RETURN AIR, RA = 5,500 - 170

RA = 5,330 CFM

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h. MIXED AIR CONDITION

$$T_M = \frac{93 \times 170 + 78 \times 5330}{5500} = 78.6°F$$

i. ENTERING AIR CONDITION

$T_{EDB} = 78.6°F DB$
$T_{EWB} = 65.7°F WB$
$h_E = 30.5 BTU/LB$

j. LEAVING AIR CONDITION

$T_{LDB} = 78.6 - (78.6 - 57.8)(1 - 0.10)$
$= 59.9°F DB$
$T_{LWB} = 58.6°F WB$
$h_L = 25.5 BTU/LB$

K. GRAND TOTAL HEAT LOAD

$GTHL = 5,500 \times 4.46 \times (30.5 - 25.5)$
$= 122,000 BTUH$

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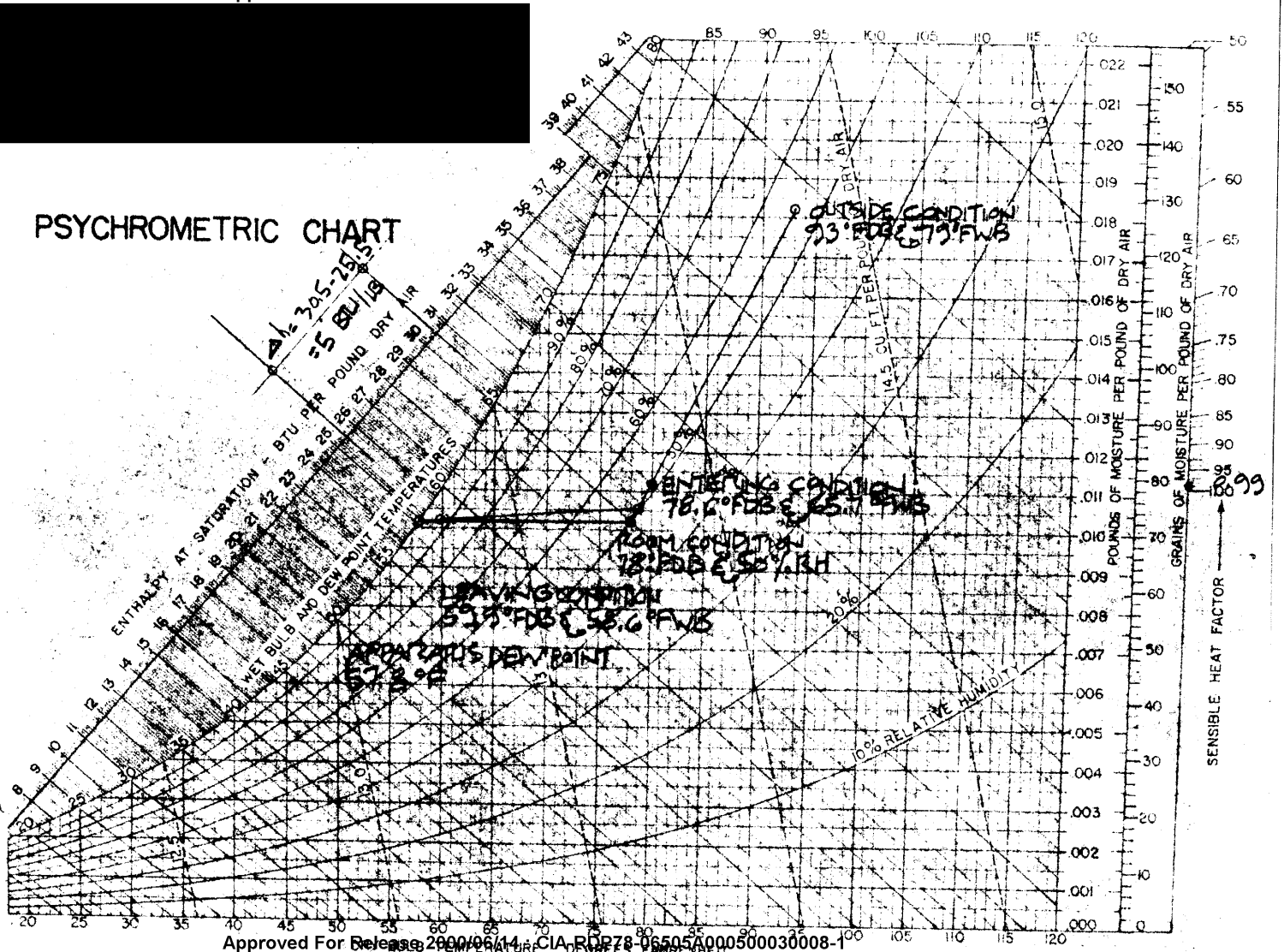

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ASHRAE PSYCHROMETRIC CHART

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A/C LOAD CALCULATION (AHU-4 & 5 DRAW-THRU SYSTEM)

1. RSH = 369,020 BTUH
2. RLH = 1,550 BTUH
3. RTH = 370,570 BTUH
4. OUTSIDE AIR, OA = 350 CFM
   OA = 175 CFM/UNIT
5. OASH = 350 × 1.08 × 15 = 5,680 BTUH
6. OALH = 350 × 0.68 × 56 = 13,300 BTUH
7. OATH = 5,680 + 13,300 = 18,980 BTUH
8. FAN MOTOR HEAT GAIN
   ASSUME STATIC PRESSURE = 1¼" WG & 20°F TEMPERATURE DIFFERENCE BETWEEN ROOM & SUPPLY AIR.
   FMSH = 0.025 × 369,020 = 9,220 BTUH
9. GRAND TOTAL HEAT LOAD
   GTHL = 370,570 + 18,980 + 9,220
   = 398,770 BTUH
   = 199,385 BTUH/UNIT
10. COIL CONDITIONS
   ASSUME 10% BY-PASS FACTOR
   a. ERSH = 369,020 + 9,220 + (0.10 × 5680)
   = 378,810 BTUH
   b. ERLH = 1,550 + (0.10 × 13,300)
   = 2,880 BTUH
   c. ERTH = 378,810 + 2,880
   = 381,690 BTUH
   d. ESHF = $\frac{378,810}{381,690}$ = 0.99

e. APPARATUS DEW POINT = 57.8°F

f. SUPPLY AIR, SA = $\frac{378,810}{1.08 \times (1-0.10) \times (78-57.8)}$

SA = 19,200 CFM

= 9,600 CFM/UNIT

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g. RETURN AIR, RA = 19,200 - 350
RA = 18,850 CFM
= 9,425 CFM/UNIT

h. MIXED AIR CONDITION
$T_M = \frac{93 \times 350 + 78 \times 18,850}{19,200} = 78.2°F$

i. ENTERING AIR CONDITION
TEDB = 78.2°FDB
TEWB = 65.3°FWB
h_E = 30.15 BTU/LB

j. LEAVING AIR CONDITION
TLDB = 78.2 - (78.2 - 57.8)(1 - 0.10)
= 59.8°FDB
TLWB = 58.5°FWB
h_L = 25.45 BTU/LB

k. GRAND TOTAL HEAT LOAD
GTHL = 19,200 x 4.45 x (30.15 - 26.45)
= 402,000 BTUH
= 201,000 BTUH/UNIT

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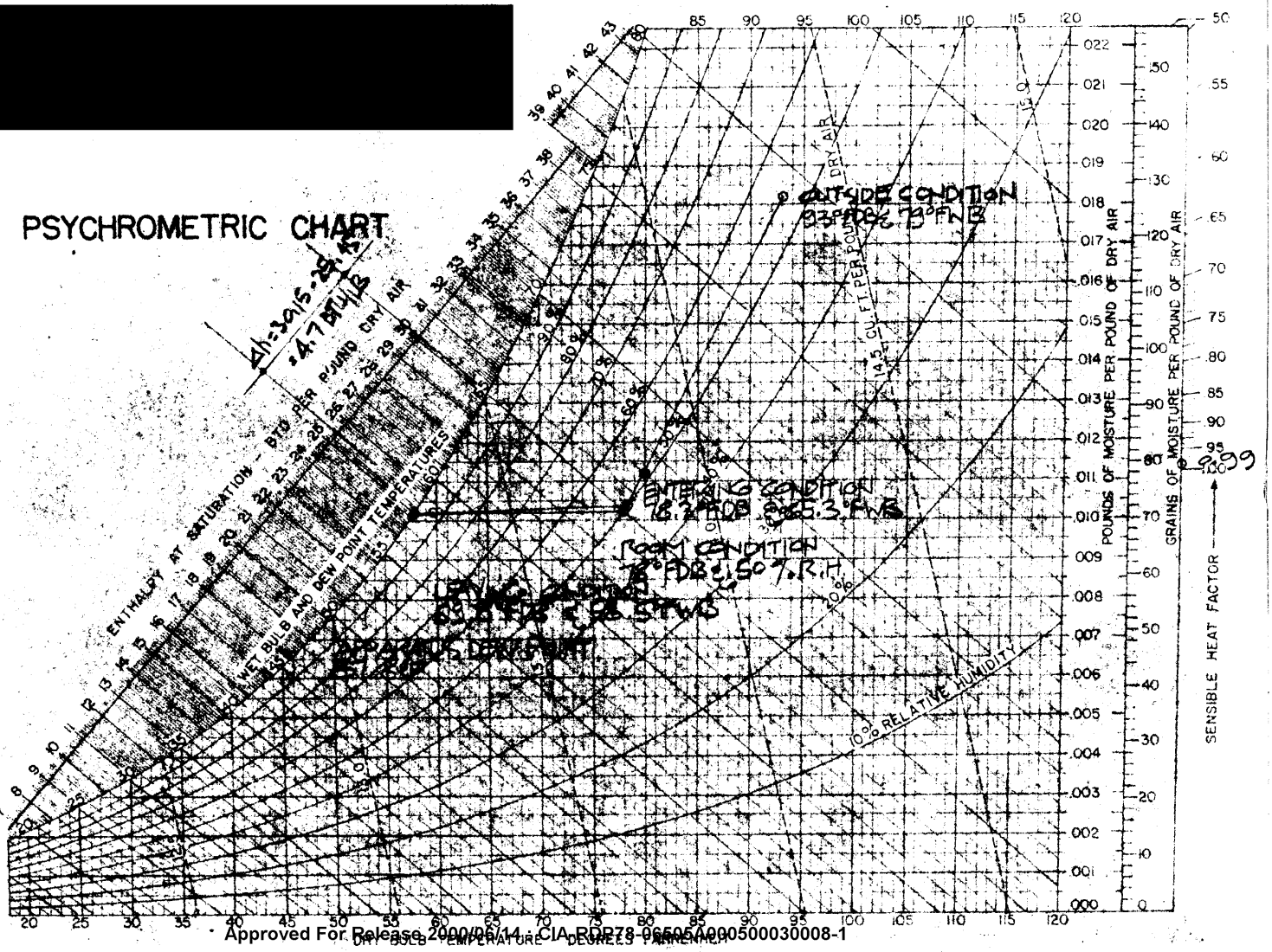

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ASHRAE PSYCHROMETRIC CHART

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SUMMARY OF AIR QUANTITY

DESIGNATION	SUPPLY AIR SA, CFM	OUTSIDE AIR OA, CFM	RETURN AIR RA, CFM
RECEPTION & LOUNGE ROOM	750	60	690
OFFICE	450	60	390
OFFICE	400	40	360
OFFICE	350	50	300
OFFICE	450	50	400
EQUIP. ROOM	1100	70	1030
VAULT AREA	250	40	210
OFFICE	400	60	340
SUB-TOTAL	4150	430	3720
"A"	4700	180	4520
"B"	1400	130	1270
"C1"	1200	60	1140
"C2"	4850	160	4690
"C3"	1700	80	1620
SUB-TOTAL	13,850	610	13,240
TOTAL	18,000	1040	16,960
"D"	19,200	350	18,850
"E"	5,500	170	5330

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EQUIPMENT SELECTION REF. 28 JULY REVIEW CONFERENCE

A. AIR HANDLING UNITS

1. AHU-1

DESIGN DATA

TOTAL AIR QUANTITY = 18,000 CFM

FACE VELOCITY = 550 FPM MAX. (AS PER REF. D)

AIR SIDE: ENTERING CONDITION = 79°FDB & 66.1°FWB

LEAVING CONDITION = 59.7°FDB & 58.4°FWB

WATER SIDE: GRAND TOTAL HEAT LOAD = 442,820 BTUH

ASSUME 10°F TEMP. RISE IN COIL

CHILLED WATER RATE = $\frac{442,820}{500 \times 10}$

= 88.6 SAY 90 GPM

UNDER THE ABOVE CONDITION, SELECT A UNIT SIMILAR TO & EQUAL IN PERFORMANCE TO:

a. CARRIER MODEL 39W12 CATALOG NO. 39W-1E

CAPACITY = 18,000 CFM

ACTUAL FACE VELOCITY = 510 CFM

COIL ANALYSIS FROM REFERENCE CATALOG CHART ON PAGE 8, FOR THE ASSUMED 10% BY-PASS FACTOR & THE UNIT SELECTED, USE 6 ROWS COIL. FROM CHART ON PAGE 35 @ 8 FINS/INCH.

PRESSURE DROP = 8 FEET

ENTERING CHILLED WATER TEMPERATURE

$Tew = T_{adp} - \frac{GTH}{Q} = 57.6 - \frac{442,820}{67,000}$

$= 57.6 - 6.6 = 51.0°F$

WATER VOLUME = 25.8 GALS

b. AMERICAN STANDARD 35V

c. WORTHINGTON MODEL CM 32

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EQUIPMENT SELECTION (CONT)

2. AHU-2

DESIGN DATA

TOTAL AIR QUANTITY = 13,850 CFM
FACE VELOCITY = 550 FPM MAX. (AS PER REF D.)
AIR SIDE: ENTERING CONDITION = 78.8°FDB & 65.9°FWB
LEAVING CONDITION = 59.2°FDB & 58.1°FWB
WATER SIDE: GRAND TOTAL HEAT LOAD = 339,000 BTUH
ASSUME 10°F TEMP. RISE IN COIL

$$\text{CHILLED WATER RATE} = \frac{339{,}000}{500 \times 10}$$

$$= 67.8 \text{ SAY } 70 \text{ GAL}$$

UNDER THE ABOVE CONDITION, SELECT A UNIT SIMILAR TO & EQUAL IN PERFORMANCE TO:

a. CARRIER MODEL 39 AC11 CATALOG NO. 39 AC-1E
CAPACITY = 13,850 CFM
ACTUAL FACE VELOCITY = 513 CFM
COIL ANALYSIS FROM REFERENCE CATALOG, CHART ON PAGE 10, FOR THE ASSUMED 10% BY-PASS FACTOR & THE UNIT SELECTED, USE 6 ROWS COIL, FROM CHART ON PAGE 45 @ 8 FINS/INCH.
PRESSURE DROP = 7 FEET
ENTERING CHILLED WATER TEMPERATURE

$$T_{ew} = T_{adp} - \frac{GTH}{Q} = 57 - \frac{339{,}000}{54{,}500}$$

$$= 57. - 6.2 = 50.8°F$$

WATER VOLUME = 19.5 GALS.

b. AMERICAN STANDARD 24V
c. WORTHINGTON MODEL CVN 24

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EQUIPMENT SELECTION (CONT.)

3. AHU-3

DESIGN DATA

TOTAL AIR QUANTITY = 5500 CFM

FACE VELOCITY = 550 FPM MAX. (AS PER REF. D)

AIR SIDE: ENTERING CONDITION = 78.6°F DB & 65.7°F WB

LEAVING CONDITION = 59.9°F DB & 58.6°F WB

WATER SIDE: GRAND TOTAL HEAT LOAD = 122,000 BTUH

ASSUME 10°F TEMP. RISE

CHILLED WATER RATE = $\frac{122,000}{500 \times 10}$

= 24.4 SAY 25 GPM

UNDER THE ABOVE CONDITION, SELECT A UNIT SIMILAR TO & EQUAL IN PERFORMANCE TO:

a. CARRIER MODEL 39AC& CATALOG NO. 39AC-E

CAPACITY = 5,500 CFM

ACTUAL FACE VELOCITY = 500 FPM

COIL ANALYSIS FROM REFERENCE CATALOG, CHART ON PAGE 10, FOR THE ASSUMED 10% BY-PASS FACTOR & THE UNIT SELECTED, USE 6 ROWS COIL, FROM CHART ON PAGE 36 @ 8 FINS/INCH.

PRESSURE DROP = 2 FEET

ENTERING CHILLED WATER TEMPERATURE

$Tew = Tadp - \frac{GTH}{Q} = 57.8 - \frac{122,000}{17,400}$

$= 57.8 - 7 = 50.8°F$

WATER VOLUME = 8.2 GALS

b. AMERICAN STANDARD MODEL 118V

c. WORTHINGTON MODEL CVN 10.16

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EQUIPMENT SELECTION (CONT)

4. AHU-4 (TYPICAL TO AHU-5)

DESIGN DATA

TOTAL AIR QUANTITY = 9,600 CFM

FACE VELOCITY = 550 FPM MAX. (AS PER REF, D)

AIRSIDE: ENTERING CONDITION = 78.2°FDB & 65.3°FWB

LEAVING CONDITION = 59.8°FDB & 58.5°FWB

WATERSIDE: GRAND TOTAL HEAT LOAD = 201,000 BTUH

ASSUME 10°F TEMPERATURE RISE

CHILLED WATER RATE = $\frac{201,000}{500 \times 10}$

= 40 GPM APPROX.

UNDER THE ABOVE CONDITION, SELECT A UNIT SIMILAR TO & EQUAL IN PERFORMANCE TO:

a. CARRIER MODEL 39 AC 10 CATALOG NO. 39 AC-1E

CAPACITY = 9,600 CFM

ACTUAL FACE VELOCITY = 480 FPM

COIL ANALYSIS FROM REFERENCE CATALOG, CHART ON PAGE 10, FOR THE ASSUMED 10% BY-PASS FACTOR & THE UNIT SELECTED, USE 6 ROWS COIL, FROM CHART ON PAGE 42 @ 8 FINS/INCH.

PRESSURE DROP = 4 FEET

ENTERING CHILLED WATER TEMPERATURE

$Tew = Tadp - \frac{GTH}{Q} = 57.8 - \frac{201,000}{26,000}$

$= 57.8 - 7.75 = 50.05°F$

WATER VOLUME = 14.8 GALS.

b. AMERICAN STANDARD MODEL 18V

c. WORTHINGTON MODEL CVN 18

5. HEAT EXCHANGERS @ 35,000 BTUH @ SCREEN ROOM

CHILLED WATER RATE = $\frac{35,000}{500 \times 10} = 7$ SAY 10 GPM

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EQUIPMENT SELECTION (CONT.)

b. AIR-COOLED PACKAGE CHILLER UNIT

TWO UNITS @ 50% LOAD EACH WILL BE SPECIFIED

DESIGN DATA

GRAND TOTAL HEAT LOAD = 442,820 + 122,000 + 402,000 + 35,000

GTH = 1,001,280 BTUH or 500,910 BTU/UNIT

CHILLED WATER REQUIREMENTS

AHU-1 = 90 GPM
AHU-2 = 70 GPM (STAND-BY)
AHU-3 = 25 GPM
AHU-4 = 40 GPM
AHU-5 = 40 GPM
HEAT EXCHANGERS = 10 GPM

TOTAL CHILLED WATER RATE = 195 GPM (EXCLUDING AHU-2 & HEAT EXCHANGER)

ACTUAL CHILLED WATER REQUIRED = 205 GPM (EXCLUDING AHU-2 ONLY)

ASSUME 1.0°F TEMPERATURE DROP TO COMPENSATE FOR PUMPING & PIPING HEAT LOSSES.

ACTUAL REFRIGERATION LOAD = 205 × 500 × (10+1)
= 1,127,500 BTUH

ACTUAL UNIT CAPACITY = 563,750 BTUH or 47 TONS APPROX.

LEAVING CHILLED WATER = 50.5°F AVERAGE

ACTUAL = 50.5 − 0.5 = 50.0°F

ENTERING CHILLED WATER = 50 + 11 = 61.0°F

UNDER THE ABOVE CONDITION, SELECT TWO UNITS SIMILAR TO & EQUAL IN PERFORMANCE TO:

a. WORTHINGTON MODEL LTA 55
CAPACITY = 58.2 TONS
COMPRESSOR MOTOR = 75 HP
CONDENSING TEMPERATURE = 115°F
SUCTION TEMPERATURE = 40°F
CHILLER PRESSURE DROP = 7.1 FEET

b. DUNHAM-BUSH MODEL PC50D

c. CARRIER MODEL 30 HJ 065

NOTE: (REF. 90% REVIEW)
REQ'D APPARATUS DEW POINT IS 57.7°F AVERAGE, WHICH MIGHT NOT BE ATTAINED.
USE CHILLED WATER TEMPERATURE
LEAVING = 45°F
ENTERING = 56°F

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EQUIPMENT SELECTION (CONT.)

C. AIR-COOLED CONDENSER UNIT

TWO UNITS @ 50% LOAD EACH WILL BE SPECIFIED.

CONDENSER HEAT LOAD = 1,127,500 + 0.25 (1,127,500)
= 1,309,380 BTUH

UNIT CAPACITY = 654,690 BTUH

CONDENSING TEMPERATURE = 115°F

AMBIENT AIR TEMPERATURE = 95°F

DIFFERENCE = 20°F

UNDER THE ABOVE CONDITION SELECT TWO UNITS SIMILAR TO & EQUAL IN PERFORMANCE TO:

a. TRANE MODEL CA-600B

CAPACITY = 60 TONS NOMINAL @ 2 EQUAL CIRCUIT.

REFRIGERANT = R-22

CONDENSER FAN MOTOR = 7 1/2 HP

b. WORTHINGTON MODEL HB-600000LJ

c. DUNHAM-BUSH MODEL LSBC 5500-D

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VENTILATION

a. A/C ROOM

ROOM VOLUME = 14 x 49 x 12 = 8,322 CF
REQUIRED AIR CHANGES PER HOUR = 10
REQUIRED MIN. AIR VENTILATION = $8{,}322 \times \frac{10}{60}$ = 1,400 CFM APPROX.

RECOMMENDED:
ONE (1) EXHAUST FAN 1,400 CFM @ 1/8" WG STATIC PRESSURE, CENTRIFUGAL TYPE, ROOF MOUNTED, DIRECT DRIVEN BY AN ELECTRIC MOTOR.

b. CHILLER ROOM

ROOM VOLUME = 23 x 29 x 12 = 8,004 CF
REQUIRED AIR CHANGES PER HOUR = 10
REQUIRED MIN. AIR VENTILATION = $8{,}004 \times \frac{10}{60}$ = 1,350 CFM APPROX.

RECOMMENDED:
ONE (1) EXHAUST FAN 1,350 CFM @ 1/8" WG STATIC PRESSURE, CENTRIFUGAL TYPE, ROOF MOUNTED, DIRECT DRIVEN BY AN ELECTRIC MOTOR.

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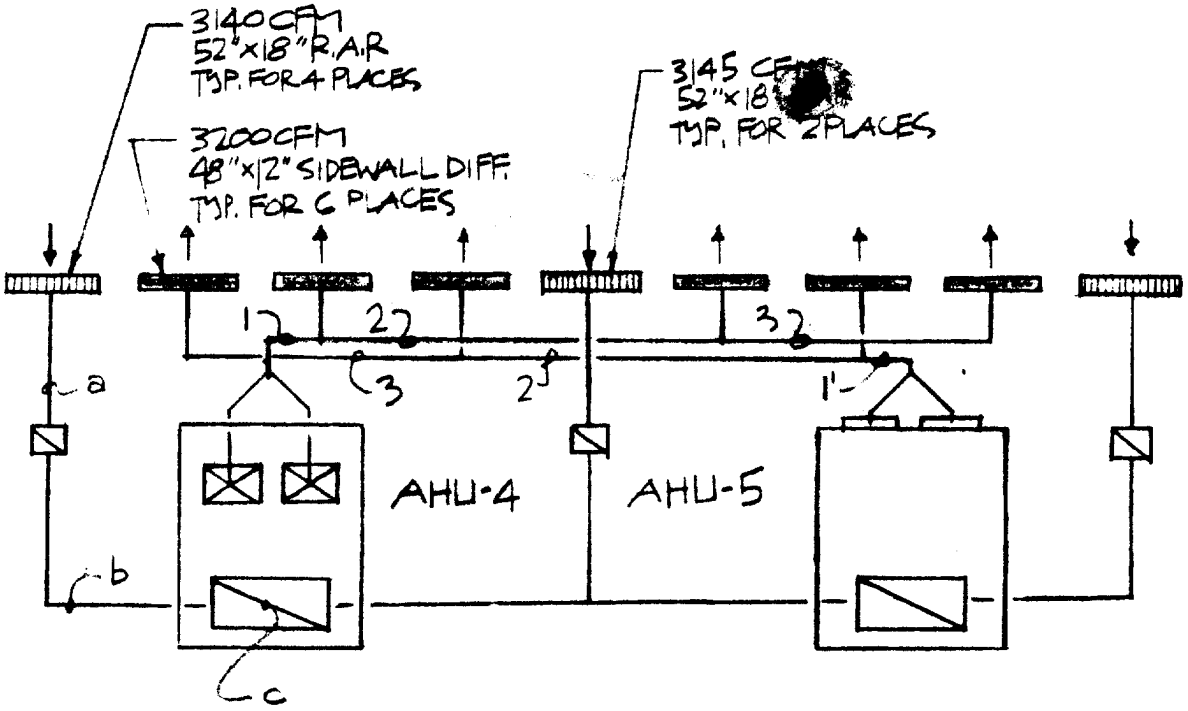
A/C DUCT LAYOUT (SUPPLY & RETURN)



A/C DUCT CALCULATION

RECOMMENDED VELOCITY = 1600 FPM

FRICTIONAL LOSS PER 100' = 0.10 "WG

SECTION	AIR QUANTITY CFM	VELOCITY FPM	FRICTION LOSS INCH OF WATER	DUCT SIZE INCHES
1 & 1'	9,600	1,600	0.09"	40"x24" 30"x30"
2	6,400	1,520	0.10"	30"x22"
3	3,200	1,260	0.10"	20"x22"
a	3,140	1,250	0.10"	28"x14"
b	6,280	1,500	0.10"	24"x28"
c	9,425	1,600	0.089"	38"x24"

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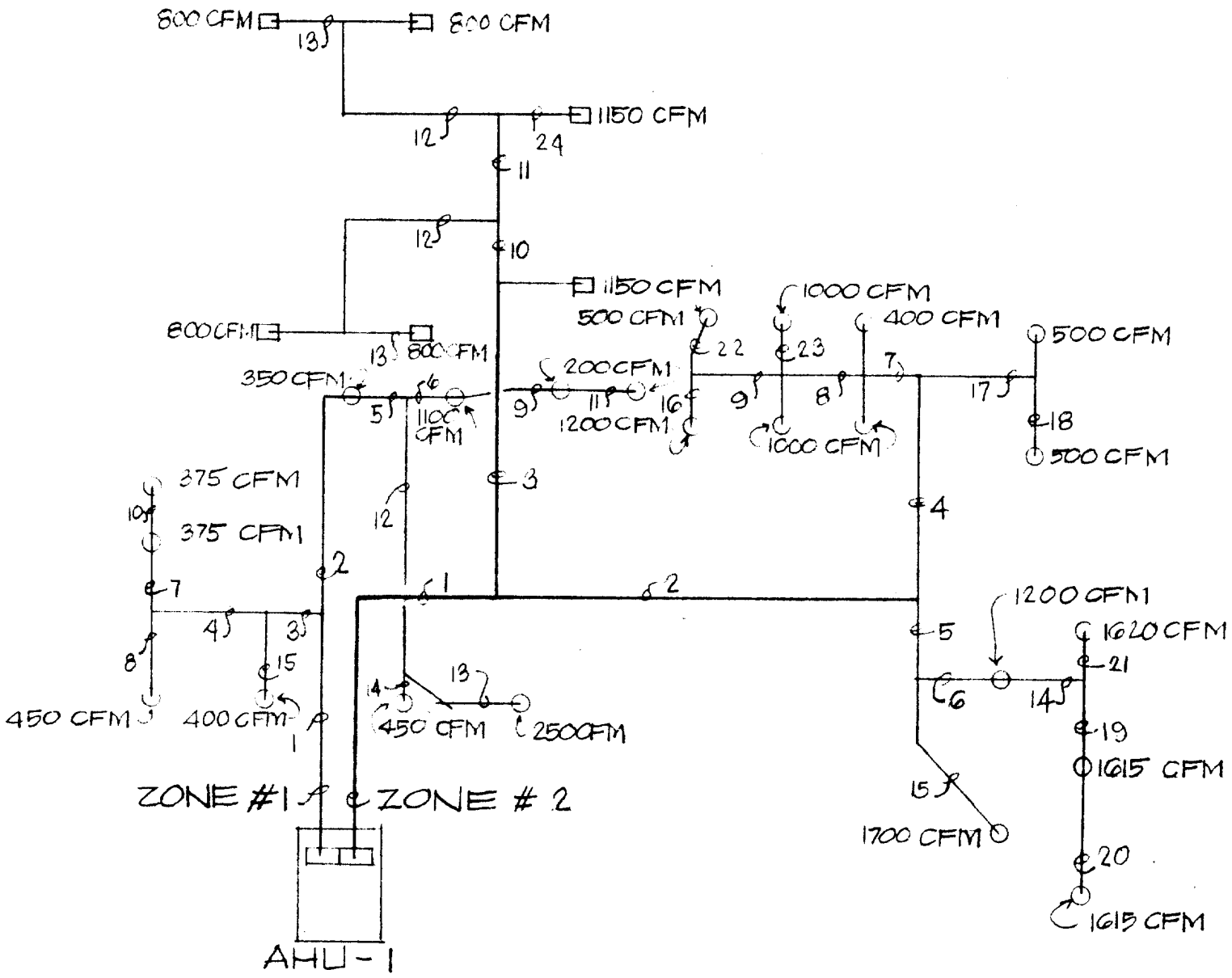

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A/C DUCT CALCULATION SUPPLIED BY AHU-1

ZONE #1

DUCT SEC.	AIR SUP. CFM	VEL. FPM	FRICTION LOSS IN. OF WATER	DUCT SIZE INCHES
1	4150	1220	0.085	48 x 12
2	2550	560	0.015	36 x 20
3	1600	540	0.0172	26 x 18
4	1200	530	0.02	26 x 14
5	2200	500	0.012	34 x 20
6	1500	600	0.023	28 x 14
7	750	495	0.022	20 x 12
8	450	400	0.017	18 x 10
9	400	250	0.006	20 x 12
10	375	380	0.016	20 x 8
11	200	250	0.009	16 x 8
12	700	395	0.013	30 x 10
13	250	150	0.008	20 x 10
14	450	500	0.032	18 x 8
15	400	320	0.011	20 x 10

ZONE #2

1	13850	2400	0.17	50 x 20
2	13850	2400	0.17	50 x 20
3	5500	1850	0.178	30 x 16
4	6100	1120	0.048	44 x 20
5	7750	1600	0.10	44 x 18
6	6050	1500	0.10	42 x 16
7	5100	1000	0.04	54 x 16
8	3700	1200	0.08	44 x 12
9	1700	1050	0.09	22 x 12
10	4350	1650	0.16	24 x 16
11	2750	1680	0.22	22 x 12

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ZONE #2 CONT'

DUCT SEC.	AIR SUP. CFM	VEL. FPM	FRICTION LOSS IN. OF WATER	DUCT SIZE IN INCHES
12	1600	1500	0.22	14 X 12
13	800	1550	0.395	14 X 6
14	4850	1400	0.10	42 X 14
15	1700	1080	0.092	22 X 12
16	1200	460	0.014	26 X 16
17	1000			
18	500	495	0.028	16 X 10
19	3230	1300	0.11	34 X 12
20	1615	1100	0.10	24 X 10
21	1620	1100	0.10	24 X 10
22	500	420	0.021	18 X 10
23	1000	620	0.031	22 X 12
24	1150			14 X 10

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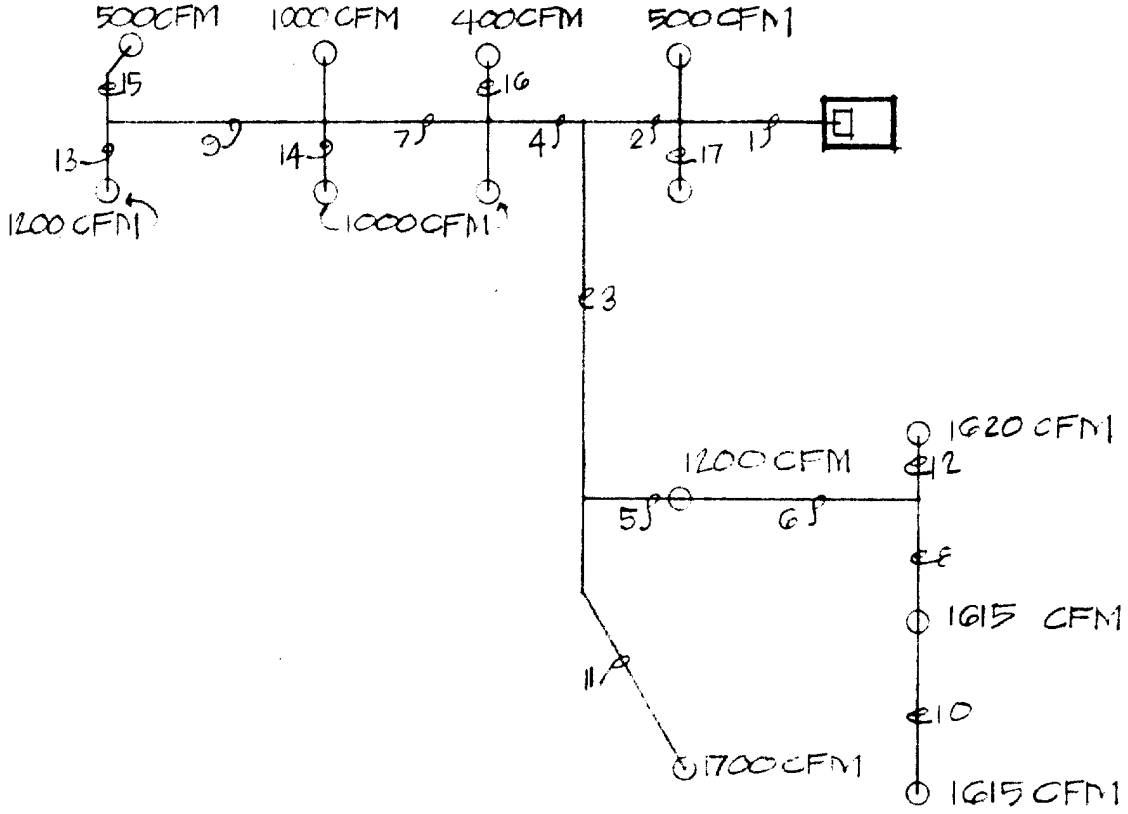

DUCT SEC.	AIR SUP. CFM.	VEL. FPM	FRICTION LOSS IN. OF WATER	DUCT SIZE IN INCHES
1	4150	1220	0.085	48X12
2	2550	560	0.015	36X20
3	1600	540	0.017	26X18
4	1200	730	0.020	26X14
5	2200	500	0.012	34X20
6	1500	600	0.023	28X14
7	750	495	0.022	20X12
8	450	400	0.017	18X10
9	400	250	0.006	20X12
10	375	380	0.016	20X8
11	200	250	0.009	16X8
12	700	395	0.013	30X10
13	250	150	0.008	20X10
14	450	500	0.032	18X8
15	400	320	0.011	20X10

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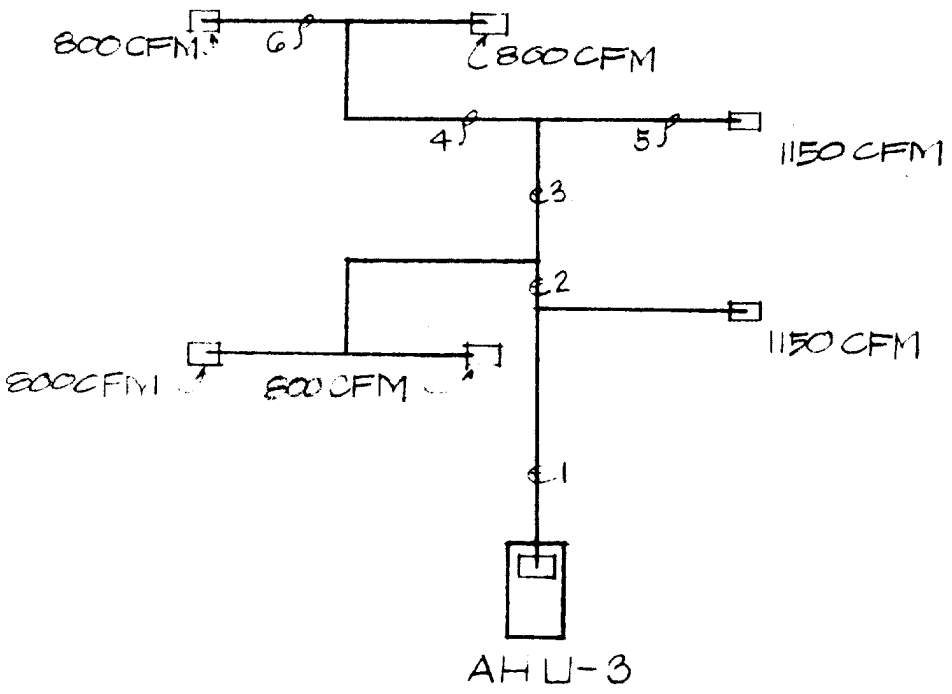

DUCT SEC.	AIR SUP. CFM	VEL. FPM	FRICTION LOSS IN. OF WATER	DUCT SIZE INCHES
1	5500	1850	0.178	30×16
2	4350	1650	0.16	24×16
3	2750	1680	0.22	22×12
4	1600	1550	0.22	14×12
5	1150	1300	0.19	14×10
6	800	1550	0.399	14×6

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CHILLED WATER PIPE SIZING REF: CAMERON HYDRAULIC DATA

RECOMMENDED VELOCITY = 4 TO 8 FPS

NOTE: @NORMAL CONDITION AHU-1, 3, 4 & 5 ARE RUNNING WHILE AHU-2 WILL SERVE AS

CHILLED WATER REQUIREMENTS:

AHU-1 = 30 GPM
AHU-2 = 70 GPM
AHU-3 = 25 GPM
AHU-4 = 40GPM (TYP TO AHU-5)
HEAT EXCHANGER = 10 GPM

@ 205 GPM USING A 4"ϕ STD. WEIGHT STEEL PIPE
VELOCITY = 5.18 FPS > 4 < 8
HEAD LOSS = 4.5 FT/100'

@ 195 GPM USING A 4"ϕ STD. WEIGHT STEEL PIPE
VELOCITY = 4.92 FPS > 4 < 8
HEAD LOSS = 4.1 FT/100'

@ 105 GPM USING A 3"ϕ STD. WEIGHT STEEL PIPE
VELOCITY = 4.56 FPS > 4 < 8
HEAD LOSS = 4.9 FT/100'

@ 80 GPM USING A 2½"ϕ STD. WEIGHT STEEL PIPE
VELOCITY = 5.36 FPS > 4 < 8
HEAD LOSS = 8.5 FT/100'

@ 70 GPM USING A 2"ϕ STD. WEIGHT STEEL PIPE
VELOCITY = 6.69 FPS > 4 < 8
HEAD LOSS = 15.8 FT/100'

@ 40 GPM USING A 1½"ϕ STD. WEIGHT STEEL PIPE
VELOCITY = 6.3 FPS > 4 < 8
HEAD LOSS = 18.9 FT/100'

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CHILLED WATER PIPE SIZING (CONT.)

@ 25 GPM USING 1 1/4" ø STD. WEIGHT STEEL PIPE
VELOCITY = 5.36 FPS > 4 < 8
HEAD LOSS = 16.8 FT/100'

@ 10 GPM USING A 3/4" ø STD. WEIGHT STEEL PIPE
VELOCITY = 6.02 FPS > 4 < 8
HEAD LOSS = 37.8 FT/100'

@ 102.5 GPM USING A 3" STD. WEIGHT STEEL PIPE
VELOCITY = 4.45 FPS > 4 < 8
HEAD LOSS = 4.69 FT/100'

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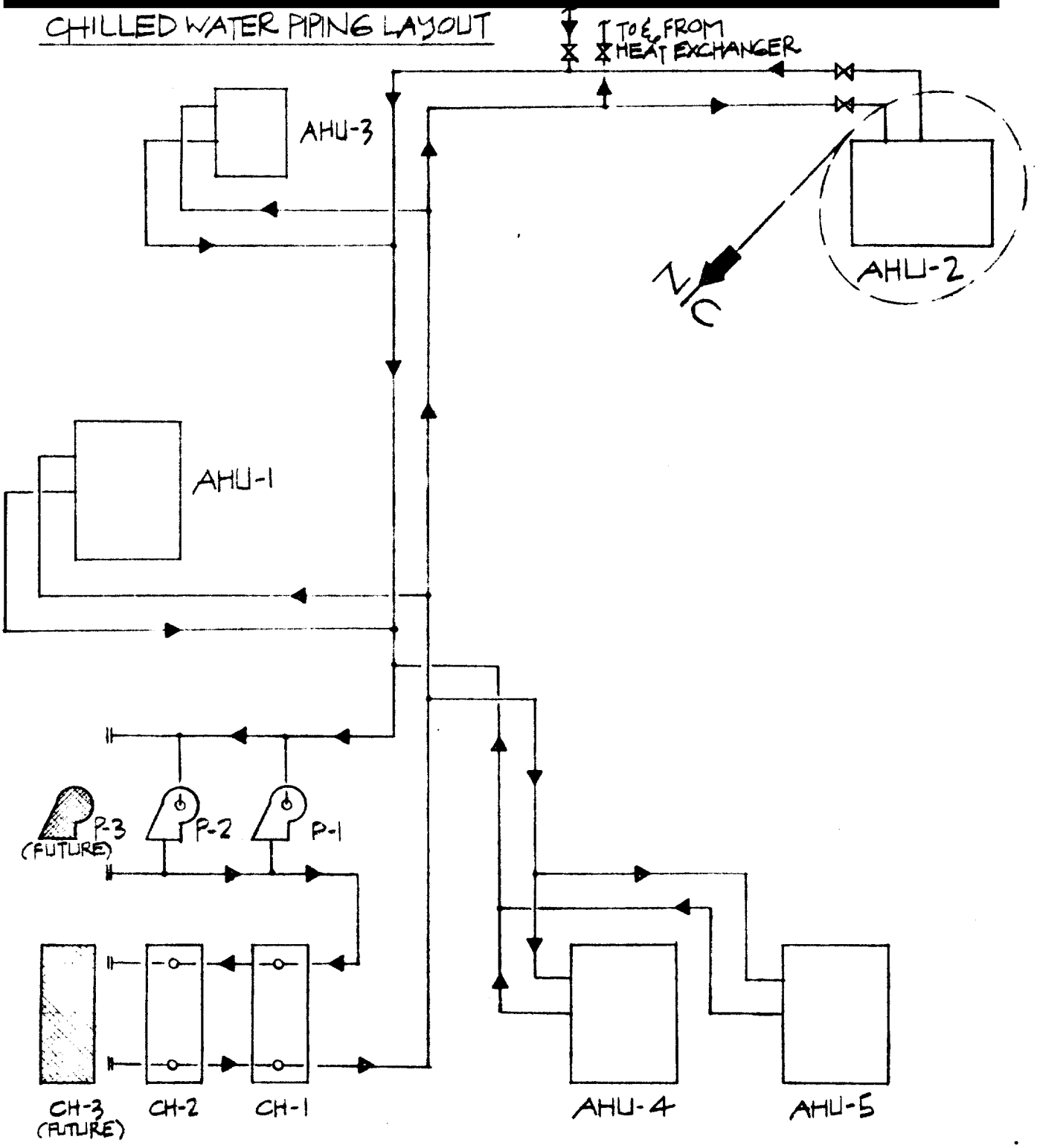

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CHILLED WATER PUMP SELECTION

TWO (2) UNITS @ 100% LOAD EACH WILL BE SPECIFIED, ONE UNIT TO SERVE AS BACK-UP.

TOTAL CHILLED WATER TO BE CIRCULATED = 20 GPM @ NORMAL OPER. (AS COMPUTED)

CHILLED WATER TEMPERATURES
- ENTERING = 56 °F
- LEAVING = 45 °F
- AVERAGE = 50.5 °F

SPECIFIC GRAVITY @ 50.5°F = 1 APPROX.

$$\text{BHP of MOTOR} = \frac{\text{GPM} \times \text{TDH} \times \text{SG}}{3960 \times \text{PUMP EFF.}}$$

USE PUMP EFFICIENCY = 50%

TDH (TOTAL DYNAMIC HEAD) = STATIC HEAD + LOSSES THRU PIPES, VALVES & FITTINGS + LOSSES THRU EQUIPMENTS.

◉ NOTE:
a. IN COMPUTING THE PUMP TOTAL DYNAMIC HEAD FOR A CLOSED LOOP PIPING SYSTEM, CIRCUIT HAVING THE HIGHEST PRESSURE DROP WILL MEET THE REQUIRED HEAD.
b. BY INSPECTION, TDH WILL FROM CH-1 TO AHU-2, AHU-2 BACK TO P-1 & THEN P-1 BACK AGAIN TO CH-1.
c. FOR COMPLETE PIPING & CLARIFICATION SEE (1/M4) & (1/M5)
d. FOR CLOSED LOOP PIPING SYSTEM, STATIC HEAD IS NEGLIGIBLE.

LOSSES THRU PIPES, VALVES & FITTINGS
HEAD LOSSES: SEE PAGES 33 & 34

FROM CH-1 TO AHU-2

3"ø @ 102.5 GPM
PIPE = 5 x 0.0469 = 0.235 FT
90° ELBOW = 1 x 7.7 x 0.0469 = 0.360 FT
GATE VALVE = 1 x 1.6 x 0.0469 = 0.075 FT
TOTAL = 0.670 FT

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CHILLED WATER PUMP SELECTION (CONT.)

4"Φ @ 205 GPM
PIPE = 25 × 0.045 = 1.12 FT
90° ELBOW = 3 × 10.2 × 0.045 = 1.38 FT
TEE = 3 × 10.2 × 0.045 = 1.38 FT
TOTAL = 3.88 FT

3"Φ @ 105 GPM
PIPE = 50 × 0.049 = 2.45 FT
TEE = 2 × 7.7 × 0.049 = 0.75 FT
TOTAL = 3.20 FT

2"Φ @ 80 GPM
PIPE = 40 × 0.085 = 3.30 FT
90° ELBOW = 3 × 3.5 × 0.085 = 0.89 FT
TEE = 1 × 3.5 × 0.085 = 0.30 FT
TOTAL = 4.49 FT

2"Φ @ 70 GPM
PIPE = 70 × 0.158 = 11.05 FT
90° ELBOW = 3 × 3.5 × 0.158 = 1.66 FT
GATE VALVE = 2 × 1.1 × 0.158 = 0.35 FT
TOTAL = 13.06 FT
SUB-TOTAL = 25.30 FT

FROM AHU-2 TO P-1

2"Φ @ 70 GPM
PIPE = 70 × 0.158 = 11.05 FT
90° ELBOW = 3 × 3.5 × 0.158 = 1.66 FT
TEE = 1 × 3.5 × 0.158 = 0.55 FT
GATE VALVE = 1 × 1.1 × 0.158 = 0.17 FT
GLOBE VALVE = 1 × 58 × 0.158 = 9.05 FT
TOTAL = 22.48 FT

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CHILLED WATER PUMP SELECTION (CONT.)

2"ϕ @ 80 GPM

PIPE = 40 × 0.085 = 3.30 FT
90° ELBOW = 3 × 3.5 × 0.085 = 0.89 FT
TEE = 1 × 3.5 × 0.085 = 0.30 FT

TOTAL = 4.49 FT

3"ϕ @ 105 GPM

PIPE = 50 × 0.049 = 2.45 FT
90° ELBOW = 1 × 7.7 × 0.049 = 0.375 FT
TEE = 1 × 7.7 × 0.049 = 0.375 FT

TOTAL = 3.20 FT

4"ϕ @ 205 GPM

PIPE = 30 × 0.045 = 1.35 FT
90° ELBOW = 4 × 10.2 × 0.045 = 1.84 FT
TEE = 2 × 10.2 × 0.045 = 0.92 FT
GATE VALVE = 1 × 2.1 × 0.045 = 0.09 FT
Y-STRAINER = 1 × 36 × 0.045 = 1.62 FT

TOTAL = 5.82 FT

SUB-TOTAL = 35.99 FT

FROM P-1 TO CH-1

4"ϕ @ 205 GPM

PIPE = 20 × 0.045 = 0.90 FT
90° ELBOW = 4 × 10.2 × 0.045 = 1.84 FT
TEE = 2 × 10.2 × 0.045 = 0.92 FT
GATE VALVE = 1 × 2.1 × 0.045 = 0.09 FT
CHECK VALVE = 1 × 26 × 0.045 = 1.17 FT

TOTAL = 4.92 FT

3"ϕ @ 102.5 GPM

PIPE = 5 × 0.0469 = 0.235 FT
90° ELBOW = 1 × 7.7 × 0.0469 = 0.360 FT
GATE VALVE = 1 × 1.6 × 0.0469 = 0.075 FT

TOTAL = 0.67 FT

SUB-TOTAL = 5.59 FT

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CHILLED WATER PUMP SELECTION (CONT.)

TOTAL OF SUB-TOTALS = 25.3 + 35.99 + 5.59 = 66.88 FT

LOSSES THRU AHU-2 COIL = 7 FT.
LOSSES THRU CHILLER = 7.1 FT.

HENCE, TDH = 66.88 + 7 + 7.1 = 79.08 FT SAY 80 FT

THEREFORE, BHP OF MOTOR = $\frac{205 \times 80}{3960 \times 0.50}$ = 8.28 HP USE 10 HP STD.

RECOMMENDED:

TWO (2) CENTRIFUGAL PUMP, SPLIT CASE, SINGLE STAGE, SINGLE SUCTION, 205 GPM CAPACITY @ 80 FT TDH, DIRECT DRIVEN BY 10 HP ELECTRIC MOTOR.

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EXPANSION TANK SIZING REF. G

$$V_T = \frac{E \times V_S}{P_a (1/P_F - 1/P_o)}$$

WHERE:

V_T = MINIMUM CAPACITY OF TANK (GALLONS)
V_S = TOTAL VOLUME OF WATER IN THE SYSTEM (GALLONS)
E = PERCENT INCREASE IN THE VOLUME OF WATER IN THE SYSTEM
P_a = PRESSURE IN THE EXPANSION TANK WHEN WATER FIRST ENTERS, USUALLY ATMOSPHERIC (FEET OF WATER ABSOLUTE)
P_F = INITIAL FILL OR MINIMUM PRESSURE AT THE EXPANSION TANK (FEET OF WATER ABSOLUTE)
P_o = MAXIMUM OPERATING PRESSURE AT THE EXPANSION TANK (FEET OF WATER ABSOLUTE)

SPECIFIC VOLUME OF WATER @ 85°F = 0.01609 CF/LB
SPECIFIC VOLUME OF WATER @ 55.1°F = 0.01603 CF/LB (@ AVE. TEMP.)
NET EXPANSION = 0.01609 − 0.01603 = 0.00006 CF/LB
HENCE,

$$E = \frac{0.00006 \times 100}{0.01609} = 0.372$$

P_a = 34 FT ; P_F = 10 FT ; P_o = 90 + 34 = 124 FT

TOTAL VOLUME OF WATER IN THE SYSTEM, V_S

1. VOLUME OF WATER IN PIPING (@ NORMAL OPERATION)

a.	3/4"Ø PIPE	40 × 0.0277	= 1.11 GAL
b.	1 1/2"Ø PIPE	40 × 0.0777	= 3.10 GAL
c.	2"Ø PIPE	70 × 0.1058	= 7.40 GAL
d.	2 1/2"Ø PIPE	220 × 0.249	= 54.8 GAL
e.	3"Ø PIPE	110 × 0.384	= 42.1 GAL
f.	4"Ø PIPE	75 × 0.661	= 49.50 GAL
		TOTAL =	158.01 GAL

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EXPANSION TANK SIZING (CONT')

2. VOLUME OF WATER IN CHILLERS
TOTAL = 2 × 38.2 = 76.4 GALS.

3. VOLUME OF WATER IN AHU COILS (@NORMAL OPERATION)
TOTAL = 25.8 + 8.2 + 2 × 14.8 = 63.6 GALS.

HENCE, V_S = 158.01 + 76.4 + 63.6 = 298.01 GALS.

THEREFORE, $V_T = \frac{0.372 \times 298.01}{34(1/10 - 1/124)}$ = 35.4 GALS USE 40 GALS STD.

RECOMMENDED:
ONE(1) EXPANSION TANK, 40 GALS CAPACITY, WELDED STEEL CONFORMING TO ASME CODE FOR UNFIRED PRESSURE VESSEL.

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I. REFERENCES:

1. Scope of Work Under Contract
2. Power Plant Engineering by Morse
3. Power Plant Theory and Design by Potter
4. Cameron Hydraulic Data
5. Diesel Engineering Handbook

II. DAY TANK SIZE

Criteria is for 1-235 KW & the 175 KW to be running at the same time.
Total BHP for 2 units = 540

Average fuel consumption = 0.45 lb/BHP-HR.

Fuel consumption rate = $\frac{0.45 \times 540}{6.713}$ = 36.2 gals./hr.

Assuming day tank capacity is to hold fuel for 6 Hrs. continuous operation.
Tank capacity = 36.2 x 6 = 210 gals.
Tank size = 3'Ø x 4' height

III. FUEL OIL TRANSFER PUMP

Fuel oil transfer pump is to remain the same. Since it is automatic in operation, pump capacity of 3 GPM is still adequate to meet the fuel demand at full load operation. Rechecking for pumping head for new day tank, exist pump head of 25 psi is still capable of delivering 3 GPM from fuel storage tank to day tank.

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III. FUEL OIL TRANSFER PUMP (Cont'd)

Pump Suction Head

For a 3/4"Ø suction line at 3 GPM pressure loss = 4 feet/100' of pipeline. Approximate length of suction line including fittings = 150'

Therefore, pressure drop = $\frac{4 \times 150}{100}$ = 6 feet

Static suction head = 0

Total suction head 6 feet

Pump Discharge Head:

Approximate length of discharge line including fittings = 35 feet

Pressure drop = $\frac{4 \times 35}{100}$ = 1.4 feet

Static discharge head = 5 feet

Total discharge head = 6.4 Or Say 7

Therefore, pump total dynamic head = 6 + 7

= 13 feet

IV. VENTILATION REQUIREMENT

Based on maintaining 104°F (40°C) ambient with 94°F outside D.B. Heat load assumed at 25 KW dissipated by motor & generator .

$$\frac{25 \text{ KW} \times 3413}{(104-94) \times 1.08} = 8{,}000 \text{ CFM}$$

Select 1 roof ventilator similar to ILG Electric Ventilating Co. Type L-CRF 245

Capacity 8,250 CFM at 1/8" S.P. Power input 2 HP.

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